

Resource Collection:

Plants: Anatomy, Growth and Function

Aliya Waheed, Anu Jain, Sam Hong, Saralyn Covent and Stephanie Smith

Ontario Institute for Studies in Education (OISE)

Category	Resource Type
Nature of Science (NOS)	2. History: Sustainable Agriculture
Basic Concepts of Science	4. Dry Lab: Transpiration in Plants 6. Hook: Burning Jack-Pine Cones
Skills of Inquiry & Communication	3. Wet Lab: Growing Radish Plants
Relationship Amongst Sciences, Technology, Societies, and Environments (STSE)	1. Recent Research Developments: Self-Sustaining Communities 5. Contemporary Issues-Based Case Study:

Unit Plan 3

Part 1: The Resources 4

1. Recent Research Developments: Self-Sustaining Communities 5

Lesson Outline Day 1 6

Lesson Outline Day 2 7

Teacher Notes 8

Appendix A: ABIP Network Resource List 10

Appendix B: Student Handout 11

Appendix C: Teacher Copy of Student Handout 12

Appendix D: Advertisement Research Assignment Rubric 13

Appendix E: Scaffolding: Concept Map Template 14

2. History: Sustainable Agriculture 15

Lesson Outline 16

Teacher Notes 17

Appendix A1: student handout 19

Appendix A2: Time map instructions 20

Appendix A3: Example of what a completed Wallwisher 21

3. Wet Lab: Growing Radish Plants 22

Teacher Notes 23

Appendix A: Student Handout 24

Appendix B: Assessment of Plant Growth Lab 25

Appendix C: Teacher Handout Notes 26

Appendix D: Assessment of Plant Growth Lab: Teacher's Copy 27

4. Dry Lab: Transpiration in Plants 28

Lesson Outline 29

Appendix A: Drops on a Penny 30

Appendix B: Drops on a Penny – Teacher Copy 31

Appendix C: Plant Transpiration Lab 32

Appendix D: Plant Transpiration Lab-Teacher Copy 35

5. Contemporary Issues-Based Case Study: The Question of Biofuels 38

Lesson Outline 39

Teacher Notes 40

Appendix A: Student Handout 42

Appendix B: Possible Posters 45

Appendix C: Resource 1 46

Appendix D: Resource 2 49

Appendix E: Resource 3 52

Appendix F: Resource 4 54

6. Hook: Opening Jack Pine Cones 57

Lesson Outline 58

Appendix A: Burning Jack Pine Cones 59

Appendix B: Burning Jack Pine Cones – Teacher Copy 60

Part Two: The Summative Test 61

SBI3U Summative Test: Student Copy 62

SBI3U Summative Test: Teacher Copy 68

Unit Plan

The Question of Biofuels F1.1 AforL – formative feedback bias/logical arguments	Plant Mind Mapping Intro. Growth Lab F2.2, 2.4; A1.1,1.5 AasL – mind map AforL – growth lab method check	Succession F3.4, 3.5; A1.1, 1.11 AforL – teacher observation of group work	Recent Research Introduction Computer Lab	Begin Growth Lab F2.2, 2.4; A1.5 Jack Pine Cones F2.1, 3.5 Review Gymno/Angiosperms AforL – Teacher checks for understanding as lab begins
Recent Research Day 2 Computer Lab	Biodiversity F3.4, 3.5	Plant Reproduction F2.4, 3.3	Progress Check (Research/Growth Lab) Introduction to Agriculture in Society F1.2 AasL – Progress self-eval	The History of Agriculture F1.2
Review Quiz Monocots/Dicots F3.2, 3.3 AofL	Plant Tissues F2.3, 3.1	Transport Exit Card F2.3, 3.1 AforL—Exit card: 3 things learned; 3 questions I still have	Qualitative Tissue Lab F2.3, 2.4, 3.1 AforL – formative feedback on in class work	Work Period*
Transpiration Dry Lab F2.3, 3.1, 3.4 AofL – marked in-class lab	Growth Lab Work Period*** A1.6, 1.8, 1.10, 1.11 AasL – Students work together on lab results and analysis	Presentations** AofL AasL—peer and self-assessments	Review	Test** AofL

* Note: There should be a weekend between this work period and the presentation date

**Note: This date is somewhat flexible and would be agreed upon by the teacher and the students.

***Note: This lab will be due after the test on a date chosen by the students and teacher together; when turned in it will be Assessment of Learning.

Part 1: The Resources



1. Recent Research Developments: Self-Sustaining Communities

Course: Grade 11 Academic Biology	Course Code: SBI3U
Unit Title: Plants	Topic: Self-Sustaining Communities (2 days)
Lesson Title: Research in Self-Sustaining Agriculture	
Category: Relationships Amongst Sciences, Technologies, Societies and Environments (STSE)	

Curriculum Expectations addressed:

A1.3 identify and locate a variety of print and electronic sources that enable them to address research topics ...
A1.7 select, organize, and record relevant information on research topics from a variety of appropriate sources, including electronic, print, and/or human sources, using suitable formats and an accepted form of academic documentation
A1.9 analyse the information gathered from research sources for logic, accuracy, reliability, adequacy, and bias
F1.1 evaluate, on the basis of research, the importance of plants to the growth and development of Canadian society (e.g., as a source of food, pharmaceuticals, Aboriginal medicines, building materials, flood and erosion control; as a resource for recreation and ecotourism) [IP, PR, AI, C]
F1.2 evaluate, on the basis of research, ways in which different societies or cultures have used plants to sustain human populations while supporting environmental sustainability (e.g., sustainable agricultural practices in developing countries such as crop rotation and seed saving; traditional Aboriginal corn production practices) [IP, PR, AI, C]

Assessment Tasks/Activities, Strategies and Recording Devices:

Tasks/Activities	Assessment Strategies	Assessment Types	Recording Devices
-Class Discussion -Expert Research Groups -Critical analysis of research -Ecological Design research	-observation -concept map and presentation -advertisement	A for L A as L A of L	-teacher notes -concept map -rubric

Instructional Focus:

Teaching/Learning Strategies: <ul style="list-style-type: none"> • Ted Talk Video followed by discussion and questions • Research in groups, create concept maps and present • Critically analyze research networks • Research components of ecological design and produce advertisements 	Student Groupings: <ul style="list-style-type: none"> • as a class • groups of 3-4 self-determined • predetermined pairs based on ability
Differentiation Strategies: For research groups: roles (researcher, concept mapper, speaker) are self-assigned. Advertisements: option of topics, option of any medium i.e. poster, video, audio, pamphlet, etc.	
Adaptations/Accommodations for Exceptional Students: For the video subtitles are possible, video also posted online for later viewing. For discussion write all questions large and neatly on the board and read aloud. For group research scaffolding for exceptional students can be provided in concept mapping. For research assignment extend due date if need be. Spend time on building research skills.	

Notes and Reminders

-this is a two-day lesson plan, both days meet in the computer lab -collect concept maps -ensure students get class time for research assignment and leave with a topic and an article

Lesson Outline Day 1			
Objectives (learning goals): By the end of the class the students will be able to describe one current research project in detail.			
20	Minds On	<p>Inspiring self-sustaining community in other cultures</p> <ul style="list-style-type: none"> Show Green School video: http://www.ted.com/talks/lang/en/john_hardy_my_green_school_dream.html Discuss the self-sustainable community shown in the video Ask students if they know what biofuels, renewable bioenergy, biomass feedstock and self-sustaining communities are. 	<p>Rationale for choice of T/L Strategy:</p> <ul style="list-style-type: none"> -Introduces the topic of sustainable communities in different cultures -Students get to discuss amongst peers -Teacher can gauge prior knowledge
40	Action	<p>How is Canada striving towards a self-sustaining community?</p> <ul style="list-style-type: none"> Divide students into 8 groups Assign each group a number from 1-8. Each number corresponds to an ABIP network (Appendix A). Each member of every group is assigned the role of researcher, concept mapper, or speaker. Students have to research their network and organize their information in the form of a concept map. 	<p>Rationale for choice of T/L Strategies:</p> <ul style="list-style-type: none"> -Makes the connection between sustainable communities in other cultures and in Canada -Students will become aware of government-funded research projects in Canada -Students get the opportunity to engage in their own research. -Concept mapping refines organizational skills and make it easier for students to understand each network
10	Consolidation and Debrief	<ul style="list-style-type: none"> Speaker will present information about network to the class in a 2-3 minute presentation. 	<p>Notes: Class in the computer lab</p>
5	Next Steps	<ul style="list-style-type: none"> Conclude class and discuss what will happen in the next class 	

Lesson Outline Day 2			
Objectives (learning goals): By the end of the class students will have begun research into one aspect of ecological design. By the end of the project the students will be able to argue in favour of their chosen aspect of ecological design using their research.			
20	Minds On	Thinking critically about current research in Canada: <ul style="list-style-type: none"> Review research networks studied in last class. Write networks on board along with main purpose. Students Form expert groups again and critically evaluate the value of each network. Pose questions about how it is valuable and if the amount of money being spent on it is valid. Do you support the research? In their groups ask students to decide which network they found most important and valuable. One representative from each group voices their opinion with regards to how the particular network will be most beneficial in reaching a self-sustaining society in Canada to the rest of the class. 	Rationale for choice of T/L Strategy: <ul style="list-style-type: none"> -This will require students to think critically about current research -Students will get a chance to debate amongst peers about what is more important for Canadian agriculture practices -Gives students an opportunity for
50	Action	What are the components of a self-sustaining community? <ul style="list-style-type: none"> Pick an aspect of ecological design (permaculture, ecological building, green production, alternative energy, etc.) find an article on that topic. Create infomercial/ advertisement in the form of pamphlet, brochure, poster, video, or audio. 	Rationale for Choice of T/L Strategy: <ul style="list-style-type: none"> -Gives students the chance for individual research outside of class -Giving options differentiates project -Students will learn aspects of ecological design in depth
n/a	Consolidation and Debrief	<ul style="list-style-type: none"> Students will make a video (5 mins) of their infomercial advertisement put it on Youtube and send me the link Teacher will embed all videos on Prezi and show it the class 	Note: This class will take place in a computer lab.
5	Next Steps	<ul style="list-style-type: none"> Finish for homework. Students will get one more work period later in the unit, but should plan on doing much of this project on their own time 	

Teacher Notes

Lesson Plan: Self-Sustaining Communities

Grade and Unit: Grade 11 - Plants: Anatomy, Growth, and Function

Minds On (20 minutes):

1. Have key words (biofuels, alternative renewable energy, permaculture, self-sustaining) written on the board. Ask students to think about them while watching the video.
2. Show Ted Talk video (14 minutes): This inspirational video will open a window into self-sustaining communities in other cultures for students.
http://www.ted.com/talks/lang/en/john_hardy_my_green_school_dream.html
3. Discussion (7 minutes): After the video, ask students to highlight techniques being used in the video, and draw connections back to how/if they can be implemented in Canada. Probe students for knowledge of biofuels, biochemicals, renewable bioenergy, permaculture, etc.

Group Research (50 minutes):

1. Introduce Agricultural and Bioproduct Innovation Program (ABIP) and the 8 research networks.
2. Divide class into 8 groups of 3-4 students, number groups 1-8 and assign each a ABIP network.
3. Each student in every group will be assigned a role of researcher, concept mapper, or speaker.
4. Direct students to resource sheet posted online (appendix A), for starting off their research. Give students 25 minutes for research.
5. Instruct concept mappers in each group to organize their researched information into a concept map. (Note: At this point in the term students have been taught concept mapping)
6. Speaker from each expert group will present their findings to the class with help of concept map in 2-3 minutes.

Day 2:

Consolidation for previous day's work-Thinking Critically about Current Research (20 minutes):

1. Ask students to return to their expert research groups.
2. Ask students to come up to the board to write down a research network studied the previous day and the main goal of the research conducted in that network.
3. Ask students to think about the value of these research networks. Pose questions like which network they think is most valuable and why, is the amount of money funded for it valid? How will it help create sustainable communities in Canada?
4. One representative from each group will voice the groups' opinion to the rest of the class.

Components of Ecological Design Research Assignment (50 minutes):

1. Introduce assignment (Appendix B) to the class and assign pairs.
2. Go over required elements of the advertisement and the rubric provided.
3. Rest of the class time will be spent working on the assignment
4. Supervise students during research time, make sure students leave knowing their topics and having found at least one scientific article.
5. Students have option of what medium they use for advertisement.
6. Once students have made their infomercial/advertisement ask them to make a 5 minute video of it and post it on Youtube. Once students send the Youtube link embed videos on Prezi to show to the class. (Note: This will not happen during class but sometime later in the unit)

Appendix A: ABIP Network Resource List

Agricultural Bioproduct Innovation Program:

<http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1314803481043&lang=eng>

1. Industrial Oil Seed Network (IOSN):

<http://agwest.sk.ca/events/plantbio-oils08/Grushcow.pdf>

2. Cellulosic Biofuel Network (CBioN)

http://www.cellulosic-biofuel.ca/cbnwiki/Main_Page

3. Canadian Triticale Biorefinery Initiative (CTBI)

<http://www.ctbi.ca/>

4. Sustainable Cropping System Platforms for Biodiesel Feedstock Quantity and Quality (SBQQ)

<http://www.4fcrops.eu/pdf/madrid/Harker.pdf>

5. Agricultural Biorefinery Innovation Network for Green Energy, Fuels and Chemicals (ABIN)

<http://www.abin-ribba.com/>

6. Feed Opportunities from the Biofuels Industries (FOBI)

http://www.ddgs.usask.ca/Portals/0/About_FOBI_FII_Mar9_2010.pdf

7. Pulse Research Network (PURENet)

<http://www.pulsecanada.com/food-and-nutrition/research/on-going-research-projects>

8. BioPotato Network

<http://bioatlantech.nb.ca/site/news/item/46>

Appendix B: Student Handout

Advertising Components of Ecological Design Research Assignment

1. Research an aspect of ecological design seen in the Ted Talk (permaculture, ecological building, green production, alternative energy, etc.). Research must consist of at least one scientific article.
2. Create an infomercial/advertisement for your component of ecological design in the form of pamphlet, brochure, poster, video, audio, (Other mediums require teacher approval). The advertisement/infomercial must include:
 - a. **Who** will the type of ecological design help?
 - b. **What** is this type of ecological design?
 - c. **Where** is this type of ecological design going to be used?
 - d. **When** will this type of ecological design be implemented on a test scale? On a broader scale?
 - e. **Why** is this type of ecological design beneficial to the people involved? To the country? To the planet?
 - f. **How** are people going about implementing this sort of ecological design?
 - g. What is the **future vision/direction** of the research?
3. Make a video (5 minutes maximum) of the infomercial/advertisement. Put it on Youtube. Send the link to the teacher for the class to watch.
4. Be aware of the project requirements by making reference to the attached rubric.

Appendix C: Teacher Copy of Student Handout Advertising Components of Ecological Design Research Assignment

1. Research an aspect of ecological design seen in the Ted Talk (permaculture, ecological building, green production, alternative energy, etc.). Research must consist of at least one scientific article. *Note: Teacher will inform students of the types of articles they can use for example, Scientific American, National Geographic, New York Times science section. The teacher should also make clear that the students are encouraged to use peer-reviewed journal articles from periodicals such as Science and Nature. The teacher should help the students to know how to locate these articles.*
2. Create an infomercial/advertisement for your component of ecological design in the form of pamphlet, brochure, poster, video, audio, (Other mediums require teacher approval). The advertisement/infomercial must include:
 - a. **Who** will the type of ecological design help?
 - b. **What** is this type of ecological design?
 - c. **Where** is this type of ecological design going to be used?
 - d. **When** will this type of ecological design be implemented on a test scale? On a broader scale?
 - e. **Why** is this type of ecological design beneficial to the people involved? To the country? To the planet?
 - f. **How** are people going about implementing this sort of ecological design?
 - g. What is the **future vision/direction** of the research?
3. Make a video (5 minutes maximum) of the infomercial/advertisement. Put it on Youtube. Send the link to the teacher for the class to watch.

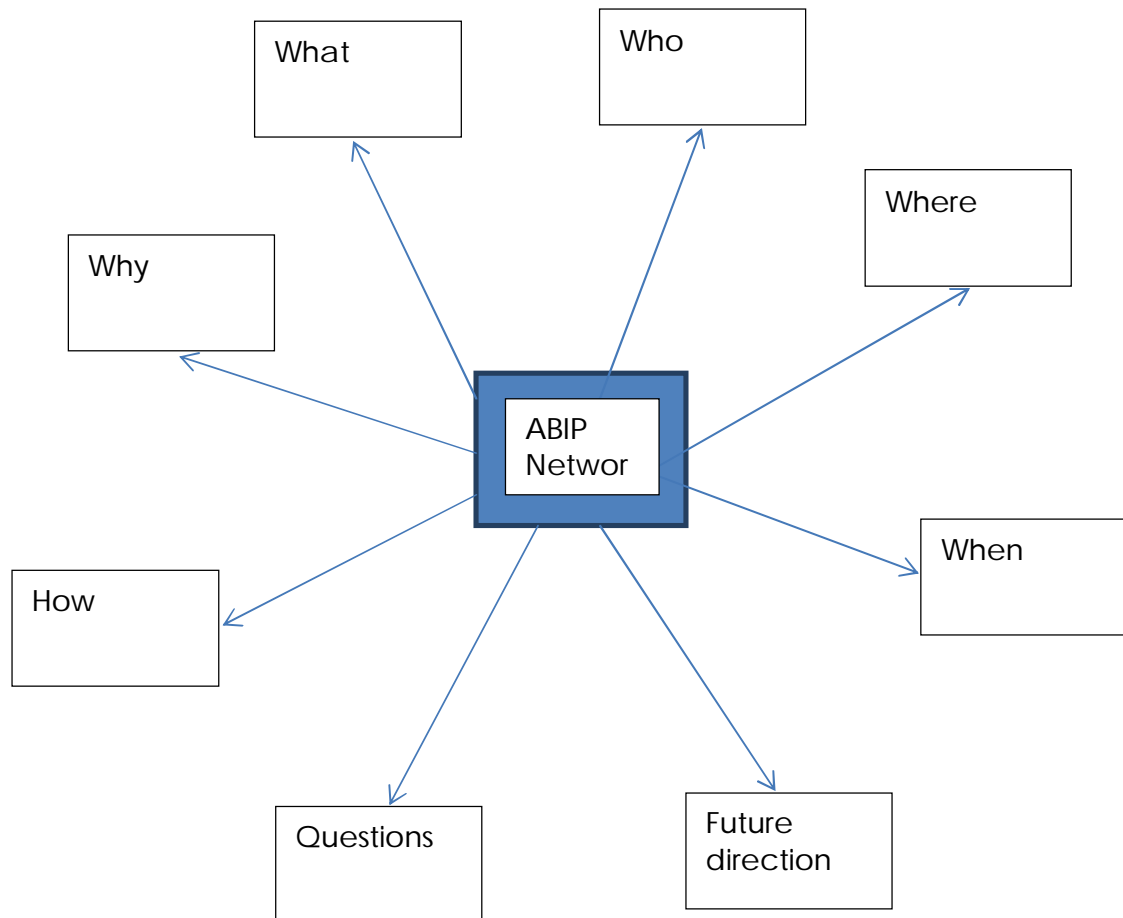
Notes:

- Before the students leave this class the teacher should have recorded who is working together, what ecological design they are studying, and what type of infomercial/advertisement the students will be working on.
- This project assumes that the students have had a chance to make videos for class before as plants is a later unit, so creating a video should not require an in class lesson, but students may request extra help at lunch or after school.
- The teacher is expected to check in with the class over the course of the unit to see how the research projects are progressing.
- The teacher will hand out the rubric with the assignment and go over the requirements. The rubric will also be reviewed during the work period at the end of the unit.

Appendix D: Advertisement Research Assignment Rubric

	Level 1	Level 2	Level 3	Level 4
Knowledge & Understanding	<p>Students demonstrate limited knowledge and understanding regarding the area of research including only some of the required elements.</p> <p>Facts are not accurate.</p>	<p>Students demonstrate some knowledge and understanding regarding the area of research including most of the required elements.</p> <p>A few (2-3) facts are accurate.</p>	<p>Students demonstrate considerable knowledge and understanding regarding the area of research including all of the required elements.</p> <p>Accurate facts (4-6).</p>	<p>Students demonstrate thorough knowledge and understanding regarding the area of research including and going beyond the required elements.</p> <p>Substantial accurate facts (7+).</p>
Thinking & Investigation	<p>Limited planning skills are evident in their selection of included material: Article was not relevant.</p> <p>Limited analysis skills are evident in the interpretation of the research.</p>	<p>Some planning skills are evident in their selection of included material; Article is somewhat relevant.</p> <p>Some analysis skills are evident in the interpretation of the research.</p>	<p>Considerable planning skills are evident in their selection of included material; Article is relevant.</p> <p>Considerable analysis skills are evident in the interpretation of the research.</p>	<p>Thorough planning skills are evident in selection of included material; Article is highly scientific, shows exemplary relevance.</p> <p>Thorough analysis skills are evident in the interpretation of the research.</p>
Application	<p>Connections were limited between the science and life in Canada.</p> <p>Knowledge gained through research is transferred with limited ease to foreign contexts</p>	<p>Connections were somewhat strong between the science and life in Canada.</p> <p>Knowledge gained through research is transferred with some ease to foreign contexts</p>	<p>Connections were considerably strong between the science and life in Canada.</p> <p>Knowledge gained through research is transferred with considerable ease to foreign contexts</p>	<p>Connections were thoroughly strong between the science and life in Canada.</p> <p>Knowledge gained through research is transferred with through ease to foreign contexts</p>
Communication	<p>Organises thoughts and work with limited effectiveness considering the audience; not engaging.</p> <p>Uses the vocabulary and terminology with limited accuracy; many grammatical errors.</p>	<p>Organises thoughts and work with some effectiveness considering the audience; somewhat engaging.</p> <p>Uses the vocabulary and terminology with some accuracy; some grammatical errors.</p>	<p>Organises thoughts and work with considerable effectiveness considering the audience; engaging.</p> <p>Uses the vocabulary and terminology with considerable accuracy; few grammatical errors.</p>	<p>Organises thoughts and work with thorough effectiveness considering the audience; very engaging.</p> <p>Uses the vocabulary and terminology with thorough accuracy; no grammatical errors.</p>

Appendix E: Scaffolding: Concept Map Template



2. History: Sustainable Agriculture

Course: Grade 11 Academic Biology	Course Code: SBI3U
Unit Title: Plants	Topic: Sustainable Agriculture
Lesson Title: Yesterday, today, and tomorrow's sustainable agriculture	
Category: Nature of Science (NOS) – how we learned about sustainable agriculture	

Curriculum Expectations addressed:

Big Idea: Plant variety is critical to the survival and sustainability of ecosystems

A1.1 formulate relevant scientific ... to focus inquiries or research

A1.3 identify and locate a variety of... electronic sources ... to address research topics fully and appropriately

A1.7 select, organize, and record relevant information on research topics ...

A1.9 analyse the information gathered from research sources ...

A1.11 communicates ... in writing, ... in electronic presentations, using... a variety of formats ...

F1. evaluate the importance of sustainable use of plants to Canadian society and other culture

F1.1 evaluate, ..., the importance of plants to the growth and development of Canadian society ...

F1.2 evaluate, ..., ways in which different societies or cultures have used plants to sustain human populations while supporting environmental sustainability

F2.4 investigate various techniques of plant propagation

F3.4 describe the various factors that affect plant growth

Assessment Tasks/Activities, Strategies and Recording Devices:

Tasks/Activities	Assessment Strategies	Assessment Types	Recording Devices
<ul style="list-style-type: none"> Gallery Walk time map Research 	<ul style="list-style-type: none"> Student presentation Collect "Time Map" Online record of posting 	As/ For Learning	<ul style="list-style-type: none"> Time map Online posting

Instructional Focus:

Teaching/Learning Strategies: <ul style="list-style-type: none"> Gallery walk Time map Online research 	Student Groupings: 3-4 people per group; teacher-made, mixed ability
Differentiation Strategies: <ul style="list-style-type: none"> For the "wallwisher" research posting, students can choose to post up a video, picture, or document related to any concept that falls under sustainable agriculture(differentiated for interest) Time map incorporates illustrations and text (differentiated for learning style) When constructing the Time Map, students have the option of using the textbook, having discussion with peers, or using the internet as a resource (differentiated for ability) 	
Adaptations/Accommodations for Exceptional Students: <ul style="list-style-type: none"> Exceptional students will be provided with assistive technology when researching(larger keyboards and larger screen) Instructions for each activity will be written on the board in large clear handwriting Exceptional students may be given extra time when researching 	

Notes and Reminders

<ul style="list-style-type: none"> Teacher will have to provide each group with 2-3 different magazines for gallery walk Should remind students the day before to bring in their laptops and textbooks Photocopy the "case study" handout beforehand

Sources

Galbraith, Donald I. <i>McGraw-Hill Ryerson Biology 11</i> . Toronto: McGraw-Hill Ryerson, 2001. Print. Dookhan, Isaac. <i>A History of the Virgin Islands of the United States</i> . Kingston, Jamaica: Canoe, 1994. Print.

Lesson Outline			
Objectives (learning goals): By the end of class students will be able to describe at least two methods of sustainable agriculture. By the end of class students will be able to state biologically, with reference to growth factors, why a given method of agriculture is or is not sustainable.			
15	Minds On	Magazine Gallery Walk: Students will be trying to answer the question: Why are plants important to society using cut-out pictures from a magazine 1. Students will be placed into groups of 4 2. Each group receives 1-2 different magazines 3. Groups must cut out one image that they feel answer the above question and write a sentence to explain 4. They glue pictures to a piece of blank paper 5. Gallery walk and group sharing	Materials and Resources Required <ul style="list-style-type: none"> • Class laptops • Old magazines • Scissors • Glue • Paper • Handouts
40	Action	Case Study and Time Map 1. Students will remain in their groups of four 2. Each group will receive the "cotton" case study. Refer to Appendix A1 3. Students will be given 15 minutes to analyze the case study 4. They will then create a Time map (refer to appendix A2) on chart paper. Students can flip to section 16.3 (pages 598-611) in their textbooks as a resource when completing the "past" and "present" section of their mind map. The internet can be used for the completion of the "future" section 5. Each group will then be given 2 minutes to present their time map to the class	
15	Consolidation and Debrief	Wall Wisher 1. Students will use their laptops to go onto the following site: http://www.wallwisher.com/wall/oiseplant 2. They will then research an answer to the following question a. What is one sustainable agricultural practice in today's society? 3. They will then post (tweet) their thoughts and links to resources on the group's "wall" (An example of a "wall" is shown in appendix A3)	Key Vocabulary <ul style="list-style-type: none"> • Sustainable agriculture • Crop rotation • Agribusiness • Soil amendment • (others depending on research)
5	Next Steps	Glogster posters http://www.glogster.com/ <ul style="list-style-type: none"> • Students will go home and look through their peer's Comments and references • They will then choose 2 comments they found interesting and create an online poster to bring in to class for group discussion the following day 	

Teacher Notes

Lesson Plan: History of Sustainable Agriculture

Grade and Unit: Grade 11 - Plants: Anatomy, Growth, and Function

Content:

Minds On: (15 minutes)

1. Organize students into groups of 3-4. Hand out 1-2 magazines, 1 pair of scissors, 1 blank piece of paper, and 1 stick of glue to each group
2. Present the question, "Why are plants important to society?" by writing it on the board.
3. Give students 5 minutes to discuss in their groups what they think the answer to the question is. They are then going to flip through the magazines and cut out one image that best represents their answer. The image is then placed onto a blank piece of paper with a quick explanatory note.
4. Once students are done, they will do a gallery walk around the room to see all the other group's images. During this time they will be placing a check mark beside the image if they agree with their opinion, a question mark if they are not too sure of the image, or an exclamation mark if they really feel that the image was very insightful
5. After the gallery walk, have a 5 minute class discussion where students shared their answer to the question

Action (40 minutes):

1. Have students remain in their groups.
2. Each group will receive the "cotton" case study handout. See Appendix A1
3. Students will be given 15 minutes to analyze the case study
4. Each group will be given 1 piece of chart paper. They will then create a Time map (refer to appendix A2) on chart paper
 - a. Students can refer to section 16.3 (pages 598-611) in their textbooks when completing the "past and present" sections of the time map
 - b. For the "future" section of the time map, students are encouraged to try and think critically and creatively to come up with their own unique idea. If they are having difficulty, then they are allowed to use the internet as a catalyst for their brainstorming.
5. Each group will then be given 2 minutes to present their time map to the class

Consolidation: (15 minutes)

1. The day before class, log onto www.wallwisher.com and create a wall with the instruction, "Share at least one sustainable agricultural practice in today's society"
2. Sign up ahead of time to get a set of laptops for the class. (This assumes the school has this available, if not other options include having student bring in laptops if possible, using cell phones with internet access, and booking a computer lab).
3. In class students will go onto the "wallwisher" wall you made and will research and post up their findings.
 - a. An example of a completed wallwisher is www.wallwisher.com/wall/oiseplant
4. This "wall" will be a way for students to share their research with their peers. This is also a way of keeping them accountable for researching.

Next steps: (5 minutes)

1. Tell students that they will have to go home and visit the classes "wallwisher" wall.
2. They will spend some time looking through their peer's wall wisher posts
3. They will then choose one of those posts that they thought was the most interesting
4. They will then create a small informative poster on Glogster.com that has pictures and texts that explains each of the sustainable agricultural practices they chose.
5. These posters will be used for an opening discussion in the next class.
6. Note: It is assumed this late in the term that the students have used Glogster for another class assignment and so this homework project should only take 15-20 minutes.

Appendix A1: student handout
Case Study:



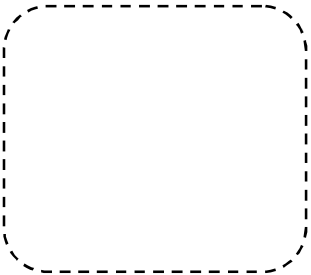
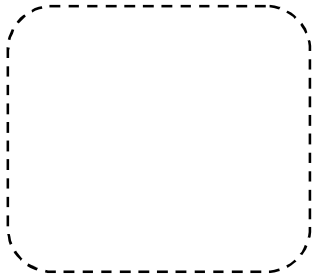
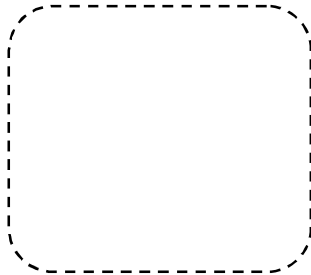
During 1770 to 1860, slave trade flourished in America. Growing cotton was a very lucrative business, and many slaves were needed to help grow and harvest the cotton crop. Cotton was the only crop that was grown on many of the plantations, because cotton was the most profitable cash crop.

When these plantations first started becoming established, large amounts of cotton crop were successfully harvested. However, as each successive year passed by, many of the plantation owners were puzzled at how there a decreasing amount of cotton was being produced from their fields. In fact, some slave owners had to start selling some of their slaves in order to cope with the gradual loss in cotton production each year. After several successive years, some of the plantations had to close down since no cotton was able to be produced from the land.

In your groups, brainstorm some of the possible agricultural causes for this loss in crop yield. Once your group has arrived at a conclusion and a well developed explanation, illustrate and explain your answer using a Time Map.

Appendix A2: Time map instructions

Hand each group of students a large piece of chart paper and a couple of different coloured markers. Have each group draw a Time map template as illustrated below.

Past	Present	Future
		

1. Once each group has drawn their mind map
2. They will illustrate the agricultural practice mentioned in the case study in the “past” portion of the mind map.
3. They will then, in point form, evaluate whether or not this practice is sustainable and give some supporting reasons for their decision
4. They will then identify a agricultural practice that is done in today’s society and also evaluate and explain their reasoning
5. Finally, they will brainstorm what they think the future holds in terms of agricultural practices. They will also illustrate and give an explanation for their choice.

Appendix A3: Example of what a completed Wallwisher



Wallwisher built by Samuel on January 13, 2012 9 posts so far

Share at least one sustainable agricultural practice in today's society
It could simply be your own creative idea, a link to a video, a website, or anything at all!

What is Sustainable Agriculture? importance of sustainable use pangaea.stanford.edu/courses/


Build a wall Go To... Do More... Help Login/Register

Samuel says
Luther Burbank used hybridation and crossbreeding to make new types of plants.
Look at how much corn has changed!

A

B



4 minutes ago ZOOM

Samuel says
Remove dams that block flooding!
Flooding is important to replenishing nutrients in the soil where wheat and barley is grown along the Euphrates and Nile River




34 minutes ago PLAY

Samuel says
Cool, new Salt Tolerant plants have been developed by scientists!
Check out this video




19 minutes ago PLAY

Samuel says
Salt Water Greenhouses can use solar energy to be used to separate fresh water from salt water.
Fresh water can then be used to water the greenhouse plants




30 minutes ago ZOOM

Samuel says
Vertical Farming!
optimize land use for farming. Farms can be then incorporated into busy cities!




24 minutes ago ZOOM

Samuel says
Biochar is a type of charcoal that is suppose to improve soil fertility.
Farmers should start using it!




17 minutes ago ZOOM

Samuel says
Use fertilizers to replenish nitrogen supplies in the soil



22 minutes ago ZOOM

Samuel says
Different types of cropping strategies
-crop rotation
-multiple cropping
-strip cropping
-strip intercropping



16 minutes ago VIEW

Samuel says
In the Green Revolution, people start to add chemicals into the soil to improve fertility. some of the chemicals can include:
-ammonium nitrate
-urea
-pH

10 minutes ago

3. Wet Lab: Growing Radish Plants

Course: Grade 11 Academic Biology	Course Code: SBI3U
Unit Title: Plants	Topic: Growing plants from seed
Lesson Title: (varied as this lesson happens over 3 periods)	
Category: Skills of Inquiry and Communication	

Curriculum Expectations addressed: (note over 3 periods and work at home)

Big Idea: Plants have specialized structures with distinct functions that enable them to respond and adapt to their environment.

A1.1 formulate relevant scientific questions ... formulate educated hypotheses to focus inquiries or research

A1.5 conduct inquiries, controlling relevant variables, ... collect observations and data

A1.6 compile accurate data from laboratory ... organize and record the data, using appropriate formats...

A1.8 synthesize, analyse, interpret, and evaluate qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis ... identify sources of bias and/or error;

A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions ...

A1.11 communicate ideas, plans, procedures, results, and conclusions orally, in writing, ..., (laboratory reports)...

F2. investigate the structures and functions of plant tissues, and factors affecting plant growth;

F2.2 design and conduct an inquiry to determine the factors that affect plant growth (e.g., the effects on plant growth of the quantity of nutrients, the quantity and quality of light, and factors such as temperature and water retention or percolation rate) [IP, PR, AI]

F2.4 investigate various techniques of plant propagation (e.g., leaf cutting, stem cutting, root cutting, seed germination) [PR]

Assessment Tasks/Activities, Strategies and Recording Devices:

Tasks/Activities	Assessment Strategies	Assessment Types	Recording Devices
<ul style="list-style-type: none"> Design experiment Begin experiment Write report 	<ul style="list-style-type: none"> Peer feedback Teacher check in Summative report 	For/of learning	Notes from peers and teacher; summative marked with checklist

Instructional Focus:

Teaching/Learning Strategies: <ul style="list-style-type: none"> Lab work Work at home (if not appropriate for class can be adapted to do the work during class time) 	Student Groupings: <ul style="list-style-type: none"> 3-4 students; teacher made; mixed ability
Differentiation Strategies: <ul style="list-style-type: none"> For interest: students have choice as to what factor to test. For ability: This lab can be done very well with factors tested ranging in difficulty and level of understanding. 	
Adaptations/Accommodations for Exceptional Students: <ul style="list-style-type: none"> Accommodations can be made on a case-by-case basis; method designed by students All instructions will be given verbally and in writing using an easy-to-read font 	

Notes and Reminders

<ul style="list-style-type: none"> This lab would be conducted over 3 lessons. They will be described in detail later

Sources

--

Overview of the Three Lessons Involved in this Wet Lab:

Teacher Notes

1. Introduction of Project/Plant Growth Lab
2. Begin Plant Growth Lab/ Plant Mind Mapping
3. Finish Plant Growth Lab

Note: The first 2 lessons occur near the beginning of the unit in order to allow enough time for the plants to grow. Approximately 2 weeks is sufficient to grow sprouts from seed.

Introduction of Project/Plant Growth Lab

This lesson is mostly a work period for two different activities. The students will work on a small research project which will be introduced during this lesson as well as the introduction to the growth lab. I will only describe the lab. On the first day students will be informed that they will be creating their own method for this lab. It is assumed that this unit will be taught near the end of the course so that the teacher has had a chance to get to know the student's abilities when it comes to writing lab reports, as this is made up by the students themselves.

During this lesson the students will be given the attached outline, which will also be explained verbally, allowing time for questions. **The teacher will specifically ensure that the idea of controls is well explained.** In addition, it must be clear to the students that they should be testing for optimal conditions, therefore if they will be testing temperature they should use moderate temperatures and not try to grow their plants outside in January.

Most of the lesson is a work period for students to write their purpose, hypothesis and method, all of which must be approved by the teacher prior to beginning the lab.

Begin Plant Growth Lab/ Plant Mind Mapping

This class will mostly be devoted to getting the students started with their labs. By planting their seeds together they can ensure that all of the group members have begun on the same day, at the same time, and in the same way. This eliminates confusion of doing the planting alone.

Finish Plant Growth Lab

This is a work period. The students have been growing their plants at home and have been recording their progress. During this period they will get together, will bring in their plants to show their group members, so that final observations can be made together. All the data can be shared at this time and the groups can work on their analysis, conclusions and discussion.

Appendix A: Student Handout

The Project

You will work in groups of four to collect data regarding how well plants grow in various conditions. In this project each student will grow plants from seed in their homes for 2 weeks. During this time each student in the group will take care of the plants in the same way and will record how the plants are growing at identified intervals. Your groups will be **designing and conducting the experiment together but you will write individual lab reports. The stated sections below will be shared.**

Your lab report should be written in the 3rd person. You should **not** use personal pronouns like I, me or we.

Introduction: Why is this topic worth studying? (1 paragraph)

***Purpose:** What are you testing? (1 sentence)

***Hypothesis:** What do you think will happen? (1 sentence)

***Materials:** What will you use? (list, be specific)

***Method:** How will the experiment be conducted? What do you need to control? (numbered instructions)

***Observation:** Both qualitative and quantitative observations from several points during the month. Should be presented in an organized way.

Analysis: What do your observations show? Can you present the information in a graph or some other fashion to make your analysis clear? Remember to explain visuals.

Conclusion: What did you find? Were your results conclusive? What were your errors? (1 paragraph)

Discussion: How do your observations relate to our world? How is this knowledge used in society? (2 or more paragraphs; explain your ideas logically and with reference to your lab)

Day 1: You should **before you leave class:**

- A purpose and hypothesis
- Start on your method; it must be finished and approved before the lab begins.
- Decide who in you group is responsible for what materials to collect before the lab**

My group:

Group member	Contact Information

**Note: the teacher will provide you with: seeds, 1 size of container, basic potting soil, you must provide the materials that you need to conduct your specific test.

Appendix B: Assessment of Plant Growth Lab

You must submit this assessment form with your lab (1 per group). The form must be signed by the teacher to show that your method was approved before your group began the lab. Individual labs will be collected by group to include this form.

Method approved: _____
Teacher's Signature Date

Criteria	Learning goals	Points
Introduction	One paragraph that demonstrates knowledge of the condition being tested and why it is worth testing. The ideas are backed up with evidence.	/3
Purpose	One sentence that clearly explains what is being tested.	/1
Hypothesis	One sentence that outlines what the group expects to happen.	/1
Materials	A complete list.	/1
Method	An ordered list. All possible controls are recognized and accounted for (2 points). The observation schedule is clearly laid out.	/4
Observations	Organized, easy to read, detailed, both qualitative and quantitative.	/3
Analysis	Uses a graphic display to show results visually. Succinctly explains the observations as seen in the display.	/3
Conclusion	One paragraph states any conclusions that can be made or that the results were inconclusive. The conclusion is justified using scientific reasoning and any errors are explained.	/3
Discussion	With reference to the ideas found throughout the report how these results can be related to the world and society. At least two connections to society or the environment must be made and those connections should be logically justified using scientific reasoning. Possible further research can also be discussed in relation to how such research would add to the results.	/4
Communication	Appropriate scientific terminology is used and correctly understood. Where necessary appropriate symbols and notation are employed.	/2
Total		/25

Appendix C: Teacher Handout Notes

The Project

You will work in groups of four to collect data regarding how well plants grow in various conditions. In this project each student will grow plants from seed in their homes for 2 weeks. During this time each student in the group will take care of the plants in the same way and will record how the plants are growing at identified intervals. Your groups will be **designing and conducting the experiment together but you will write individual lab reports. The stated sections below will be shared.**

Your lab report should be written in the 3rd person. You should **not** use personal pronouns like I, me or we.

Introduction: Why is this topic worth studying? (1 paragraph)

***Purpose:** What are you testing? (1 sentence)

***Hypothesis:** What do you think will happen? (1 sentence)

***Materials:** What will you use? (list, be specific)

***Method:** How will the experiment be conducted? What do you need to control? (numbered instructions) ([Brainstorm ideas: pollution, sunlight, different fertilizers...](#))

***Observation:** Both qualitative and quantitative observations from several points during the month. Should be presented in an organized way.

Analysis: What do your observations show? Can you present the information in a graph or some other fashion to make your analysis clear? Remember to explain visuals.

Conclusion: What did you find? Were your results conclusive? What were your errors? (1 paragraph)

Discussion: How do your observations relate to our world? How is this knowledge used in society? (2 or more paragraphs; explain your ideas logically and with reference to your lab)

Day 1: You should **before you leave class:**

- A purpose and hypothesis
- Start on your method; it must be finished and approved before the lab begins. ([Check for controls and observation schedule; students rework if not ready](#))
- Decide who in you group is responsible for what materials to collect before the lab**

My group: ([to ensure all students can contact one another](#))

Group member	Contact Information

**Note: the teacher will provide you with: seeds, 1 size of container, basic potting soil, you must provide the materials that you need to conduct your specific test.

Appendix D: Assessment of Plant Growth Lab: Teacher's Copy

Note: The student copy should be printed double sided and only one student (the most responsible needs to get it signed to show that the method has been checked.

You must submit this assessment form with your lab (1 per group). The form must be signed by the teacher to show that your method was approved before your group began the lab. Individual labs will be collected by group to include this form.

Method approved: _____
Teacher's Signature Date

Criteria	Learning goals	Points
Introduction	One paragraph that demonstrates knowledge of the condition being tested and why it is worth testing. The ideas are backed up with evidence.	/3
Purpose	One sentence that clearly explains what is being tested.	/1
Hypothesis	One sentence that outlines what the group expects to happen.	/1
Materials	A complete list.	/1
Method	An ordered list. All possible controls are recognized and accounted for (2 points). The observation schedule is clearly laid out.	/4
Observations	Organized, easy to read, detailed, both qualitative and quantitative.	/3
Analysis	Uses a graphic display to show results visually. Succinctly explains the observations as seen in the display.	/3
Conclusion	One paragraph states any conclusions that can be made or that the results were inconclusive. The conclusion is justified using scientific reasoning and any errors are explained.	/3
Discussion	With reference to the ideas found throughout the report how these results can be related to the world and society. At least two connections to society or the environment must be made and those connections should be logically justified using scientific reasoning. Possible further research can also be discussed in relation to how such research would add to the results.	/4
Communication	Appropriate scientific terminology is used and correctly understood. Where necessary appropriate symbols and notation are employed.	/2
Total		/25

4. Dry Lab: Transpiration in Plants

Course: Grade 11 Academic Biology	Course Code: SBI3U
Unit Title: Plants	Topic: Transpiration
Lesson No 14	Lesson Title: Transpiration in Plants
Teacher: Basic Concepts of Science – transpiration (molecular theory and properties of water)	

Curriculum Expectations addressed:

Big Idea: Plants have specialized structures with distinct functions that enable them to respond and adapt to their environment.

A1.1 formulate relevant scientific questions about observed relationships, ideas, problems, or issues, make informed predictions, and/or formulate educated hypotheses to focus inquiries or research

A1.8 synthesize, analyse, interpret, and evaluate qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis and whether it is consistent with scientific theory

A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions with reference to scientific knowledge

A1.11 communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats (laboratory report)

F3 demonstrate an understanding of the diversity of vascular plants, including their structures, internal transport systems, and their role in maintaining biodiversity.

F3.1 describe the structures of the various types of tissues in vascular plants, and explain the mechanisms of transport involved in the processes by which materials are distributed throughout a plant (transpiration, osmosis)

Assessment Tasks/Activities, Strategies and Recording Devices:

Tasks/Activities	Assessment Strategies	Assessment Types	Recording Devices
<ul style="list-style-type: none"> Water droplets on a coin Write report 	<ul style="list-style-type: none"> Teacher Observation Teacher check in Summative Report 	For/of learning	<ul style="list-style-type: none"> Teacher notes Summative marked with answer key

Instructional Focus:

Teaching/Learning Strategies: <ul style="list-style-type: none"> Hands-On , Kinetic Activity Round Robin Discussion Lab work-Data Analysis 	Student Groupings: <ul style="list-style-type: none"> Mixed ability
Differentiation Strategies: <ul style="list-style-type: none"> (Learning Style) This lesson includes visual, auditory, kinetic and reading components (Ability) By working in mixed ability groups all members will be able to contribute at their own level 	
Adaptations/Accommodations for Exceptional Students: <ul style="list-style-type: none"> Class space should facilitate easy movement for all students. All instructions will be given verbally and in writing (handout) using an easy-to-read font Gifted students can be encouraged to take the ideas further and connect to other units. 	

Notes and Reminders

<ul style="list-style-type: none"> Requires photocopying and use of LCD projector, speakers and computer Have all materials ready Should collect the lab in class, if students need more time a part of the next "Work Period" will be given

Lesson Outline			
Objectives (learning goals): <ul style="list-style-type: none"> By the end of the class students will be able to understand the cohesive and adhesive properties in relation to water transport. By the end of class students will be able to clearly explain the process of transpiration in relation to anatomical features and environmental conditions. 			
10	Minds On	<ul style="list-style-type: none"> Supply each group with 2 pennies Initiate predicting how many drops of water and soapy water you can fit on a coin? Distribute handout and go over instructions verbally When groups have finished the activity they should discuss among themselves what happened and why they think it happened Whole class discussion on cohesive and adhesive properties of water 	Materials and Resources Required <ul style="list-style-type: none"> 2 pennies/group 1 dropper/group 1 beaker with water/group 1 beaker with water and soap/group Safety goggles Paper towels to clean up Student handouts Computer, speakers and LCD Projector Graph Paper and rulers
50	Action	<ul style="list-style-type: none"> Watch this Ray Smears video on transpiration in a desert: http://www.youtube.com/watch?v=vxB61tGEur Address any gaps in knowledge from Minds on and video Distribute lab handout and graph paper and go over instructions verbally and visually by having students explore this virtual lab simulation: http://www.mhhe.com/biosci/genbio/virtual_labs/BL_10/BL_10.html Students will complete the transpiration lab in class 	
10	Consolidation and Debrief	<ul style="list-style-type: none"> Identify new vocabulary for the word wall; one student will write the new vocabulary on the word wall. 	Key Vocabulary <ul style="list-style-type: none"> Adhesion Cohesion Water Concentration Transpiration
5	Next Steps	<ul style="list-style-type: none"> Class: Work Period 	

Appendix A: Drops on a Penny

During this activity you will be using a dropper to place drops of water and soapy water on a penny (one at a time). You will count the drops of water until ANY amount of water runs over the edge of the penny. Then in a circle, you will each have a turn to discuss your observations with your group and be prepared to take them up with the rest of the class. Please follow the instructions below.

1. Gather all materials.
 - a. Two pennies
 - b. A beaker of water
 - c. A beaker of soapy water
 - d. A dropper
 - e. Paper towel
 - f. Safety goggles
2. Put on goggles.
3. Set the penny face up on the paper towel.
4. Use the dropper to add as many drops of water as you can without spilling water off the sides.
5. Record the amount of drops it took to make the water spill.
6. Repeat steps 2-5 and record the number of water drops.
7. Now repeat steps 2-6 for soapy water.

	<u>Predict:</u>	<u>Observed:</u>	<u>Explain:</u>
Water			
Soapy Water			

Discussion Notes:

What happened and propose a reason for this?

Why might the properties of water be helpful for water transport in the plants xylem?


Appendix B: Drops on a Penny – Teacher Copy

During this activity you will be using a dropper to place drops of water and soapy water on a penny (one at a time). You will count the drops of water until ANY amount of water runs over the edge of the penny. Then in a circle, you will each have a turn to discuss your observations with your group and be prepared to take them up with the rest of the class. Please follow the instructions below. *Organize groups of 3-4, mixed ability*

1. Gather all materials.
 - a. Two pennies – *to distribute at the beginning of class*
 - b. A beaker of water
 - c. A beaker of soapy water
 - d. A dropper
 - e. Paper towel
 - f. Safety goggles

} 1 student representative can get this for the group

} Another student representative can get these
2. Put on goggles –*soap can sting students eyes, show eye wash stations in the classroom*
3. Set the penny face up on the paper towel.
4. Use the dropper to add as many drops of water as you can without spilling water off the sides.
5. Record the amount of drops it took to make the water spill
6. Repeat steps 2-5 and record the number of water drops.
7. Now repeat steps 2-6 for soapy water – *circulate to each group and note any pre-conceived ideas*

	<u>Predict:</u>	<u>Observed:</u>	<u>Explain:</u>
Water	Many possible answers	Usually above 30 drops 	Many possible student Answers
Soapy Water	Many possible answers	Should be less than amount of water drops	Many possible student Answers

Discussion Notes:

What happened and propose a reason for this? *Have one person from each group share their groups' results and ideas*

What happens- The drops “stick” to each other on the penny and more drops of water can fit than soapy water.

Why this happens-Water is a polar molecule and forms hydrogen bonds. The polar water molecules hold on to the surface of the penny that is polar, this is known as adhesion. The hydrogen bonding allows water molecules to stick to other water molecules, this is known as cohesion.

Why might the properties of water be helpful for water transport in the plants xylem? Adhesion can allow the water molecules to hold onto the thin xylem vessels and cohesion can allow water molecules to pull each other in the xylem similar to beads on a string.

Appendix C: Plant Transpiration Lab

Introduction:

Transpiration is the evaporation of water from plants, it occurs when the stomata of the leaves are open. Since a leaf needs carbon dioxide and water for photosynthesis the plant must strike a balance between conserving water and bringing in sufficient amounts of carbon dioxide for photosynthesis. The transport of water is controlled by water concentration. Water moves from a high water concentration to a low water concentration. Transpiration from the leaf sets up a water concentration gradient that has an upward pull on water and is the major mechanism that pulls water through the xylem vascular tissue. This pull is increased by water's natural properties of adhesion and cohesion.

Below is a diagram of a tree. With a ruler, show the direction of transpiration and indicate the area of low water concentration and high water concentration.



Purpose:

Various factors can affect the rate of transpiration. We will be analyzing how the amount of light, temperature, humidity, and wind can affect the rate of transpiration in plants.

Hypothesis:

What do you think will happen? (1 sentence for each factor)

Light: _____

Temperature: _____

Humidity: _____

Wind: _____

Method:

1. Five geranium plants were grown under different environmental conditions. The conditions were as follows:
 - a. Average room
 - b. Bright Lamp: to test light
 - c. Heater: to test temperature
 - d. Mist: to test humidity
 - e. Fan: to test wind
2. Every three minutes, the water loss was measured in ml/m^2 and recorded.

What is the control in this lab? _____

Observations:

Below are the results of the experiment measured in ml/m^2 .

Table 1: Total Water Loss for different Environmental Conditions in mL/m^2

Time (min)	3	6	9	12	15	18	21
Average Room	0.2	0.4	0.6	0.8	1	1.1	1.3
Bright Lamp	0.29	0.57	1.01	1.44	1.72	2.01	2.3
Heater	0.3	0.61	0.94	1.3	1.65	1.91	2.21
Mist	0.13	0.26	0.39	0.52	0.64	0.77	0.9
Fan	0.25	0.49	0.74	1.1	1.35	1.96	2.33

Analysis:

1. Propose an explanation for the calculation of leaf surface area.

2. Create a graph based on the set of values from the observations in the provided chart paper.
3. From the graph calculate the overall rate of transpiration (per minute) for each condition.

Conclusion:

What is the relationship of each of these factors to transpiration? Explain which factor had the greatest effect on the rate of transpiration?

Discussion:

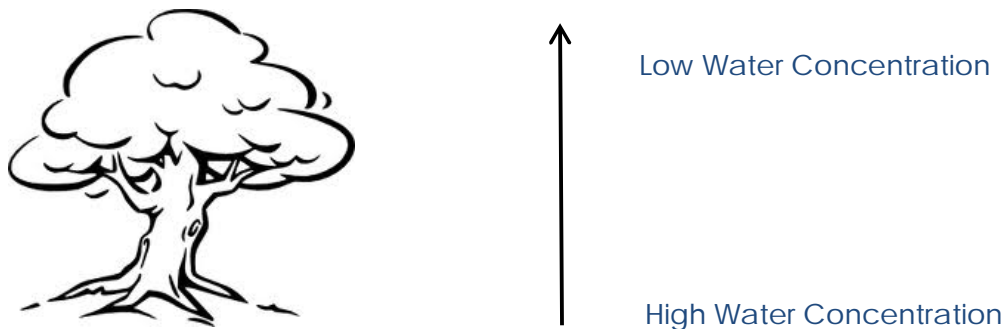
Explain why different species of plants may transpire at different rates. How does the process of transpiration relate to water conservation, or climate change? (Pick one)

Appendix D: Plant Transpiration Lab-Teacher Copy

Introduction:

Transpiration is the evaporation of water from plants, it occurs when the stomata of the leaves are open. Since a leaf needs carbon dioxide and water for photosynthesis the plant must strike a balance between conserving water and bringing in sufficient amounts of carbon dioxide for photosynthesis. The transport of water is controlled by water concentration. Water moves from a high water concentration to a low water concentration. Transpiration from the leaf sets up a water concentration gradient that has an upward pull on water and is the major mechanism that pulls water through the xylem vascular tissue. This pull is increased by water's natural properties of adhesion and cohesion. [These properties of water were explained in the prior minds-on activity.](#)

Below is a diagram of a tree. With a ruler, show the direction of transpiration and indicate the area of low water concentration and high water concentration. [Circulate around the class to check students are on the right track.](#)



Purpose:

Various factors can affect the rate of transpiration. We will be analyzing how the amount of light, temperature, humidity, and wind can affect the rate of transpiration in plants.

Hypothesis:

What do you think will happen? (1 sentence for each factor) [An increase/decrease in factor will increase/decrease the rate of transpiration.](#)

Light: _____

Temperature: _____

Humidity: _____

Wind: _____

Method:

1. Five geranium plants were grown under different environmental conditions. The conditions were as follows:
 - a. Average room
 - b. Bright Lamp: to test light
 - c. Heater: to test temperature
 - d. Mist: to test humidity
 - e. Fan: to test wind
2. Every three minutes, the water loss was measured in ml/m^2 and recorded.

What is the control in this lab? Average room because the plants are kept normal.

Observations:

Below are the results of the experiment measured in ml/m^2 .

Table 1: Total Water Loss for different Environmental Conditions in mL/m^2

Time (min)	3	6	9	12	15	18	21
Average Room	0.2	0.4	0.6	0.8	1	1.1	1.3
Bright Lamp	0.29	0.57	1.01	1.44	1.72	2.01	2.3
Heater	0.3	0.61	0.94	1.3	1.65	1.91	2.21
Mist	0.13	0.26	0.39	0.52	0.64	0.77	0.9
Fan	0.25	0.49	0.74	1.1	1.35	1.96	2.33

Analysis:

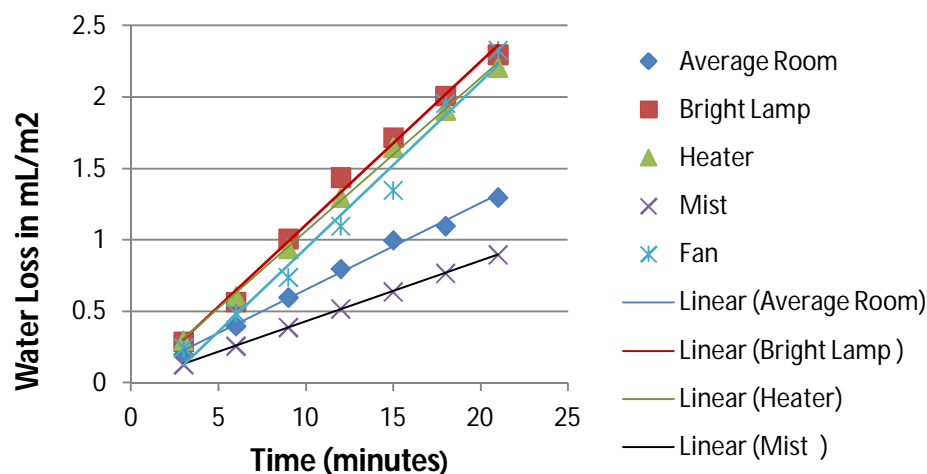
1. Propose an explanation for the calculation of leaf surface area. To assist exceptional students prompt them with a hint on the number of stomata.

Answer: The stomata on the leaves of a plant regulate transpiration. Therefore the bigger the surface area, the more water vapor lost from the plants stomata.

Create a graph based on the set of values from the observations in the provided chart paper. See next page.

2. From the graph calculate the overall rate of transpiration (per minute) for each condition. To assist exceptional students provide the hint to look at the slope of the line of best fit. As this is the last unit, students will have had prior experience on calculating the slope from a graph.

Rate of Transpiration in Different Environment Conditions



Rate of Transpiration:

- Average room: 0.0607 mL/m²/min
- Bright Lamp: to test light: 0.1145 mL/m²/min
- Heater: to test temperature: 0.1076 mL/m²/min
- Mist: to test humidity: 0.0426 mL/m²/min
- Fan: to test wind: 0.1165 mL/m²/min

Conclusion:

What is the relationship of each of these factors to transpiration? Explain which factor had the greatest effect on the rate of transpiration?

Answer: For the geranium plant the rate of transpiration increased as the light, temperature, and wind increased and the rate of transpiration decreased as the humidity increased. The fan which simulated wind had the greatest effect on the rate of transpiration as the slope of the graph was the steepest.

Discussion:

Explain why different species of plants may transpire at different rates. How does the process of transpiration relate to the water conservation, or climate change? (Pick one)
Gifted students can explain both.

**Multiple
Answers:**

5. Contemporary Issues-Based Case Study: The Question of Biofuels

Course: Grade 11 Academic Biology	Course Code: SBI3U
Unit Title: Plants	Topic: Biofuels
Lesson Title: The Question of Biofuels	
Category: Relationships Amongst Sciences, Technologies, Societies, and Environments	

Curriculum Expectations addressed:

Big Ideas: Plant variety is critical to the survival and sustainability of ecosystems.

A1.9 analyse the information gathered from research sources for logic, accuracy, reliability, adequacy, and bias

F1.1 evaluate, on the basis of research, the importance of plants to the growth and development of Canadian society

Assessment Tasks/Activities, Strategies and Recording Devices:

Tasks/Activities	Assessment Strategies	Assessment Types	Recording Devices
Jigsaw Activity Produce Action Plan	Observation Review of Action Plans/ Worksheets	A for L A as L	3-2-1 sheet Teacher notes

Instructional Focus:

Teaching/Learning Strategies:

- Think Pair Share (TPS)
- Jigsaw
- 4 Corners (seated)

Student Groupings:

- Pairs
- 8 groups of 4 of mixed ability
- Whole class

Differentiation Strategies:

- Each expert group has a resource with a different focus (differentiation for interest).
- Resource length can be adjusted further if necessary.
- Both visual and verbal texts are critically examined (differentiation for learning style).

Adaptations/Accommodations for Exceptional Students:

- Class space should facilitate easy movement for all students.
- Students with learning disabilities involving writing should participate in discussion and will receive notes later from teacher.

Notes and Reminders

- Activity involves complex group work.
- Requires photocopying (2 handouts/student) and use of LCD projector and computer.

Sources

Resources:

1. Daynard, Karen, and Terry Daynard. "What are the Effects of Biofuels and Bioproducts on the Environment, Crop and Food Prices and World Hunger?" KD Communications, April 2011. Web. 29 December 2011.
2. Canadian Renewable Fuels Association. "Ethanol Key Issues: Fact Sheet/Responses to Key Issues for Canada's Ethanol Industry." Canadian Renewable Fuels Association, August 2011. Web. 29 December 2011.
3. Coolman, Robert. "Green Gasoline Comes Closer to Fueling Your Car." *LiveScience*, 29 July 2011. Web. 29 December 2011.
4. Robenthal, Elisabeth. "Rush to Use Crops as Fuel Raises Food Prices and Hunger Fears." *New York Times*, 6 April 2011. Web. 29 December 2011.

Photo resources selected from the first page of a Google Images search for "Biofuel Poster."

Lesson Outline			
Objectives (learning goals):			
<ul style="list-style-type: none"> By the end of the class, students will be able to... <ul style="list-style-type: none"> ...based on information, state some merits and some drawbacks of biofuel use. ...state the bias in informational text and note how they recognize it. ...based on information, suggest actions to be taken by the Canadian government regarding biofuels. 			
10	Minds On	<ul style="list-style-type: none"> Students watch short video on biofuels. http://www.youtube.com/watch?v=t_Fw6y4T3Po Ask students to TPS what they already knew/learned from video. Discuss bias in film and how to detect it. Introduce action plan as goal of lesson (see Teacher notes) 	Materials and Resources Required <ul style="list-style-type: none"> Student handouts Computer + LCD projector
50	Action	<ul style="list-style-type: none"> This is a jigsaw activity. Move students into home groups. Each student in a home group gets a resource labeled 1-4 and either a or b. Students will move to their expert groups according to resource number and letter. Each student spends 15 minutes reading his/her resource and completing a 3-2-1 activity: Students in expert groups now spend 10 minutes discussing their common resource and their 3-2-1 answers. Students move back to their home groups and explain main points of their resource to their group one at a time beginning with resource 1. All other students take notes in the remaining squares of their Appendix 2 handout (15 minutes). Each home group prepares a short report about their findings and what action the government should take regarding biofuels (15 minutes). (Refer to Reverse Appendix 2) 	
10	Consolidation and Debrief	<ul style="list-style-type: none"> The government is looking for inspiration for a biofuel poster campaign. Show students images in Appendix 3 on LCD projector (seated 4 corners activity). Ask students to first think of which one(s) should they seek to emulate and why (TPS). 	
5	Next Steps	<ul style="list-style-type: none"> For homework, look up at least one of the things you need more information about from 3-2-1 activity If students are really interested, consider sending a revised and edited copy of the report to government officials. 	

Teacher Notes

Lesson Plan: The Question of Biofuels

Grade and Unit: Grade 11 - Plants: Anatomy, Growth, and Function

Content:

Minds On: (10 minutes)

1. Students watch short video on biofuels.
http://www.youtube.com/watch?v=t_Fw6y4T3Po
2. Ask students to TPS what they already knew in the video and what they had never heard before. Discuss **bias** in film and how to detect it.
3. Activity set-up: The Harper government has received a lot of criticism for not being "green" enough, so it has hired this class as a consultant on the issue of biofuels. It has asked the class to prepare reports that summarize the usefulness of biofuels and a suggestion of next steps.

Action:

6. This is a **jigsaw** activity. Seat students in 8 home groups of 4 students each (32 total). Note: Have mixed ability groupings done before class for both expert and home groups.
7. Each student in a home group gets a resource labeled 1-4 and either a or b.
8. Students will move to their expert groups where each student has the same resource according to their number and letter (1a, 1b, 2a, 2b, etc). Note: the resource for a and b groups is the same; the split according to letter is to keep groups to 4 students.
9. Each student spends **15 minutes** reading his/her resource and completing a 3-2-1 activity:
 - 3-2-1: 3 things that you find extremely important to the resource, 2 things that you do not understand very well/need more clarification for, and 1 thing you think show the bias within the resource. (Refer to Appendix 1)
Note: Each student handout is half a page
10. Students in expert groups now spend **10 minutes** discussing their common resource and their 3-2-1 answers. They fill in their resource's square on their handouts. (Refer to Appendix 2)
11. Students move back to their home groups and explain main points of their resource to their group one at a time beginning with resource 1. All other students take notes in the remaining squares of their Appendix 2 handout (**15 minutes**).
12. Each home group prepares a short report about their findings and what action the government should take regarding biofuels (**15 minutes**). Each student should record group answers on his or her own sheet. (Refer to Reverse Appendix 2)

Consolidation: (10 minutes)

1. The government is looking for inspiration for a biofuel poster campaign. Show students images in Appendix 3 on LCD projector (seated 4 corners activity). Ask students to first think of which one(s) should they seek to emulate and why, and then share that opinion with one person in their home group.
2. **Next Steps:** For homework, look up at least one of the things you need more information about from 3-2-1 activity; we'll discuss tomorrow. If students are really interested, consider sending a revised and edited copy of the report to government officials.

Note: Teacher should collect Appendix 2 handout and give formative feedback on students' action plan based on logic. After students have discussed the information they looked up for homework (as stated in previous step) teacher should collect 3-2-1 sheet and give formative feedback on students' ability to detect bias.

Resources:

1. What are the Effects of Biofuels and Bioproducts on the Environment, Crop and Food Prices and World Hunger? (2 pages-information heavy)
2. Canadian Renewable Fuel Association Fact Sheet. (2 pages information heavy)
3. Green Gasoline Comes Closer to Fueling Your Car. (1.5 pages)
4. World Hunger fears. (2.5 pages)

Lengths of readings can be adjusted according to class needs.

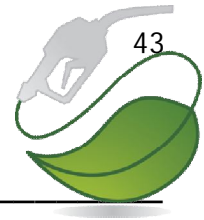


Appendix A: Student Handout

Biofuels

→ Record the important information for each resource in the boxes below. Fill in your section during your expert group discussion and the other boxes during your home group discussion.

Resource 1: _____ _____	Resource 2: _____ _____
Resource 3: _____ _____	Resource 4: _____ _____



Biofuels – Action Plan_____

→ Use the information you have collected to complete the following report. Please discuss your action plan as a group and each record your facts and suggestions.

Attn: Jim Bradley, Minister of the Environment; and Gerry Ritz, Minister of Agriculture

Given that: (List three important facts that affected your decision-making.)

1. _____

2. _____

3. _____

We recommend that: (List two steps the government should take in light of your findings.)

1. _____

2. _____

Signed,



Biofuels

3-2-1 Activity → While reading your resource in your expert group, find:

- 3 things that you find extremely important to the resource,
 -
 -
 -
 - 2 things that you do not understand very well/need more clarification for,
 -
 -
 - 1 thing you think shows the bias within the resource
 -
-

Biofuels



3-2-1 Activity → While reading your resource in your expert group, find:

- 3 facts that you find extremely important to the resource's message,
 -
 -
 -
- 2 things that you do not understand very well/need more clarification for,
 -
 -
- 1 thing you think shows the bias within the resource
 -

Appendix B: Possible Posters



Appendix C: Resource 1

What are the Effects of Biofuels and Bioproducts on the Environment, Crop and Food Prices and World Hunger?



KD Communications
(Karen Daynard) and Terry Daynard

April 2011

Key Messages and Facts

1. Biofuels and bioproducts are very positive for the environment in reducing greenhouse gas emissions and reducing fossil energy usage.
2. Biofuels have had marginal effects on Canadian and international food price increases since 2007. These small increases have been offset by the depressive effect of fuel ethanol supply/supplementation on gasoline prices.
3. Recent price spikes will stimulate future agricultural development in developing countries and depress future world grain prices.
4. Bioproducts represent an excellent opportunity to use excessive Canadian agricultural productivity while addressing other societal goals.

Development of Biofuels and Bioproducts

- Biofuels are the most developed in North America, Brazil and the European Union but are also produced in many other countries. The reasons include environmental quality, less dependence on imported petroleum products and rural economic development.
- Canada produces about 1.8 billion litres of fuel ethanol and 110 million litres of biodiesel per year. Ethanol comes from corn and wheat; biodiesel is mostly made from used cooking oil and animal fats though some comes from soy and canola oil. These numbers must grow to about 2 billion and 600 million, respectively, to meet new mandates for Canadian biofuel usage.
- About 5.7% of global grain production (3.7% after netting out byproducts) and 10% of global vegetable oil production is now used to make 85 billion and 15 billion litres of ethanol and biodiesel, respectively. The respective US numbers are 54 and 1.5 billion.
- The global production of bioproducts is about \$1-2 billion per year and the potential for growth is huge. Annual world sales of plastics are more than \$1 trillion.

Biofuels and the Environment

- Substituting 10% ethanol into gasoline in Ontario/Canada means a 62% reduction in net greenhouse gas (GHG) emissions, on a per-litre basis, adjusted for differences in the relative caloric energy content of ethanol and gasoline, including corn inputs, transportation and associated soil losses.
- The 62% reduction means an annual reduction of 2.3 million tonnes of GHG emissions, equivalent to the annual emissions from 440,000 cars, about two-thirds of this in Ontario.

Effects on Food and Gasoline Prices

- In North America, the increase in corn price caused by biofuels had less than a 1% effect on food prices. Food purchases represent only 12% of total disposal income.
 - Farmers receive only about 19% of the average retail price of food.
 - Average Canadians earn enough to pay the farmers' share of annual food purchases by January 9. Price increases caused by biofuels may have delayed this by a few hours.
 - Ethanol blending has reduced gasoline prices – i.e., compared to what would have occurred without ethanol blending – by an average of \$0.06 to \$0.10 per litre. This more than offsets the small food-price effect of ethanol on family financial well-being.
-
- Obesity and wastage, not food supply and price, are the main Canadian food problems.
 - Analyses show the effect of biofuels – and notably ethanol from corn – on world food prices was very minor. Increased oil prices were far more important.
 - The largest effects would have been in grain-deficient Latin/Caribbean countries like Mexico, where corn is the main food. However, government pricing policies often mean different prices for white food corn than for imported yellow feed corn. Mexico has a higher percent obesity than in Canada.

Future Expectations and Implications for Ontario Grain Farmers

- A 1.1% in rate of annual grain production is needed to increase total global production by 70% between 2000 and 2050. This should be achievable with the increased attention now being given to global agricultural development, after decades of neglect – even with climate change. Average world grain yield increased by 1.5% per year from 1987 to 2007.
- As food production increases in developing countries, export-oriented countries like Canada could again face serious problems in agricultural over-supply/production and depressed farm income. Slow growth in food consumption in Canada, the US and Europe will add to the problem.
- Increased production of non-food consumer products such as bioproducts represents an excellent means for addressing this impending problem.

Appendix D: Resource 2



Canadian Renewable Fuels Association

Association Canadienne Des Carburants Renouvelables

Ethanol

Key Issues

Fact Sheets/Responses to Key Issues for Canada's Ethanol
Industry

Canadian Renewable Fuels Association
08/2011

www.greenfuels.org



ISSUE: Environmental Benefits and Climate Change

Is it true that ethanol generates environmental benefits?

Yes. Ethanol is a practical alternative energy source that can be used in vehicles right now and which both lowers GHG emissions and combats smog. If Canadians are going to succeed in combating climate change, we're going to have to deal head-on with transportation fuels that generate large GHG emissions from our gas-fuelled cars, trucks and other vehicles. Ethanol is the only practical, immediately available means to lower this impact.

- **Ethanol cuts emissions from our cars.** Ethanol reduces tailpipe carbon monoxide emissions by as much as 30%, toxic content by 13% (mass) and 21% (potency) and tailpipe fine particulate matter emissions by 50%.¹¹ The 5% RFS alone will generate 4.2Mts fewer emissions – or the equivalent of removing one million cars from our nation's highways.
- **Ethanol lowers GHG's.** A new independent third party analysis of Canadian renewable fuel production conclusively confirms that based on a lifecycle assessment, Canadian produced ethanol and biodiesel significantly reduce greenhouse gas emissions. Based on feedstock, ethanol reduces GHGs by up to 62% and biodiesel by 99%.¹²
- **Ethanol replaces carcinogens in your fuel.** Ethanol actually cuts down cancer-causing emissions such as benzene from our fuel. Ethanol is an oxygenate, a fuel additive that raises the octane level of gasoline, producing a motor fuel that burns more cleanly. For example, a study by the Colorado Division of Public Health and the Environment (DPHE) study showed E10 reduced hydrocarbon pollution like benzene by 16.5%.¹³
- **Ethanol uses less energy.** The most reliable third party studies show that ethanol clearly has a positive energy balance. For one, NRCan says that corn ethanol has an energy balance that is roughly 40% superior to that of traditional fossil fuels. That rises to as much as 90% when we move from corn to cellulosic ethanol.
- **Ethanol cuts smog.** Studies show that ethanol reduces particulate matter by up to 50%, reduces tailpipe emissions by as much as 30% and reduces toxic emissions by 30%.¹⁴
- **No harm to water.** A study conducted for the Governors' Ethanol Coalition, "The Fate and Transport of Ethanol-Blended Gasoline in the Environment," concluded that ethanol poses no threat to surface water and ground water.¹⁵

¹¹ Gary Z. Whitten, Smog Reyes, AIR QUALITY AND ETHANOL IN GASOLINE, February 2004

¹² Cheminfo Services Inc., Life Cycle Assessment of Renewable Fuel Production from Canadian Biofuel Plants for 2008-2009, November 25, 2009

¹³ Brett Hulsey and Brooke Coleman, "Clearing the Air with Ethanol," Better Environmental Solutions and Renewable Energy Action Project, March 2006

¹⁴ National Corn Growers Association

ISSUE: Energy Balance

Isn't it true that ethanol has a negative energy balance?

No. Ethanol produces a decidedly positive energy balance.

- **Studies show an ethanol advantage.** NRCan says that corn ethanol has an energy balance that is roughly 40% superior to that of traditional fossil fuels. That rises to as much as 90% when we move from corn to cellulosic ethanol.
- **New plants are far more efficient.** Newly-built refineries are modernized and energy efficient practices are the standard now. Every ethanol refinery in Canada relies on natural gas and has a positive energy balance.
- **Use a lifecycle analysis.** It's important to examine energy balance based on the entire lifecycle – that is to say all the inputs and outputs involved. NRCan's GHGenius model calculates the energy required to produce renewable fuels. Since GHGenius is a lifecycle model, it takes into account the energy imbedded in the co-products from the production process and adjusts. The energy balances for renewable fuels production in Canada are all positive.
- **Rising oil prices generate environmental risks.** As prices soared well above \$100 per barrel in 2008, oil companies began exploring new sources of production that are more remote and require energy intensive extraction methods. This included deep sea drilling of the kind that has caused such controversy in the Gulf of Mexico (and subsequently a catastrophic oil spill in 2010 when BP's Deepwater Horizon rig exploded ¹⁶) – as well as the tar sands and arctic exploration. These all carry increased environmental risks, require the expenditure of even greater rates of energy, and contribute much more to greenhouse gas emissions. It is these additional sources of petroleum fuel, which will be displaced by renewable fuels such as ethanol.

¹⁵ Governors' Ethanol Coalition

¹⁶ http://en.wikipedia.org/wiki/Deepwater_Horizon_oil_spill

Appendix E: Resource 3

Green Gasoline Comes Closer to Fueling Your Car
Robert Coolman, University of Massachusetts, Amherst
Date: 29 July 2011 Time: 02:11 PM ET
www.LiveScience.com



George Huber poses with a vial of green gasoline compounds.
CREDIT: Ben Barnhart

This Behind the Scenes article was provided to LiveScience in partnership with the National Science Foundation.

The backbone of our energy infrastructure is carbon-based fuel. In the form of oil, coal and natural gas, carbon runs our cars, heats our homes and cooks our food. We can minimize the shock of transitioning away from fossil fuels to sustainable sources by using as much existing carbon-based infrastructure as possible.

Plants are the only source of sustainable carbon, in that there are no other means to simply capture carbon from the air to make carbon-based fuel. That is the beauty of plant-based biofuels and why they must have a role in our sustainable-energy future.

All life is carbon based. To convert plant-based carbon into fuels we can use in our cars, we must first understand the composition of the plants.

Plants as energy

First, think of how your body stores energy as fat but is structurally composed of a different type of molecule called protein; plants have a similar dichotomy. A plant stores energy as starch, sugar and fat, but is structurally composed of lignin and cellulose (or 'lignocellulose'). Take corn

as an example: from kernels comes starch and sugar that can be fermented to make ethanol; corn oil can be used to make biodiesel.

While those technologies deserve study in their own right, we mustn't ignore the remaining cobs, husks and stalks — the structural materials made of lignin and cellulose. Wood and grass are made of the same structural materials.

The structural materials of plants are the cheapest and most abundant forms of biomass available — plus humans can't eat them (cows and beavers can, only because their guts have special bacteria). Fuel made from inedible material has the benefit of never directly interfering with food production.

Green gasoline



Vials containing sawdust, catalyst, charred catalyst and gasoline made from sawdust.

CREDIT: Robert Coolman, UMass Amherst

Research conducted at the University of Massachusetts, Amherst headed by George Huber focuses on converting sawdust and switchgrass into "green gasoline" — a fuel that we can use within our current infrastructure. In a few years you may start seeing it blended with what you buy at the pump.

"Unless there's a sign that tells you so, you won't even know your gas is 'green,'" said Huber. "It has zero carbon footprint. The CO₂ [carbon dioxide] from your car is recycled to the plant when it re-grows."

Appendix F: Resource 4

Rush to Use Crops as Fuel Raises Food Prices and Hunger Fears



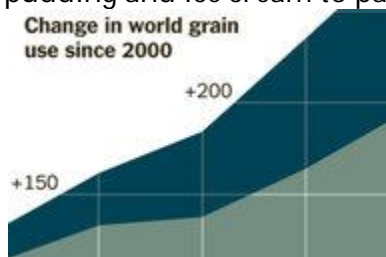
Agnes Dherbeys for The New York Times

Farmers in Thailand face a surging demand for cassava, a fairly new crop for biofuel production.

By [ELISABETH ROSENTHAL](#)

Published: April 6, 2011

The starchy cassava root has long been an important ingredient in everything from tapioca pudding and ice cream to paper and animal feed.



But last year, 98 percent of cassava chips exported from [Thailand, the world's largest cassava exporter](#), went to just one place and almost all for one purpose: to China to make biofuel. Driven by new demand, Thai exports of cassava chips have increased nearly fourfold since 2008, and the price of cassava has roughly doubled.

Each year, an ever larger portion of the world's crops — cassava and corn, sugar and palm oil — is being diverted for [biofuels](#) as developed countries pass laws mandating greater use of nonfossil fuels and as emerging powerhouses like China seek new sources of energy to keep their cars and industries running. Cassava is a relatively new entrant in the biofuel stream.

But with [food prices](#) rising sharply in recent months, many experts are calling on countries to scale back their headlong rush into green fuel development, arguing that the combination

of ambitious biofuel targets and mediocre harvests of some crucial crops is contributing to high prices, hunger and political instability.

This year, the [United Nations](#) Food and Agriculture Organization [reported that its index of food prices](#) was the highest in its more than 20 years of existence. Prices rose 15 percent from October to January alone, potentially “throwing an additional 44 million people in low- and middle-income countries into poverty,” [the World Bank said](#).

Soaring food prices have caused riots or contributed to political turmoil in a host of poor countries in recent months, including Algeria, Egypt and Bangladesh, where palm oil, a common biofuel ingredient, provides crucial nutrition to a desperately poor populace. During the second half of 2010, the price of corn rose steeply — 73 percent in the United States — an increase that the United Nations [World Food Program attributed in part](#) to the greater use of American corn for bioethanol.

“The fact that cassava is being used for biofuel in China, rapeseed is being used in Europe, and sugar cane elsewhere is definitely creating a shift in demand curves,” said [Timothy D. Searchinger](#), a research scholar at [Princeton University](#) who studies the topic. “Biofuels are contributing to higher prices and tighter markets.”

...

Olivier Dubois, a bioenergy expert at the Food and Agriculture Organization in Rome, said it was hard to quantify the extent to which the diversions for biofuels had driven up food prices.

“The problem is complex, so it is hard to come up with sweeping statements like biofuels are good or bad,” he said. “But what is certain is that biofuels are playing a role. Is it 20 or 30 or 40 percent? That depends on your modeling.”

While no one is suggesting that countries abandon biofuels, Mr. Dubois and other food experts suggest that they should revise their policies so that rigid fuel mandates can be suspended when food stocks get low or prices become too high.

“The policy really has to be food first,” said [Hans Timmer](#), director of the Development Prospects Group of the [World Bank](#). “The problems occur when you set targets for biofuels irrespective of the prices of other commodities.”

...

More distant or indirect impacts are considered to be likely, however. Because cassava chips have been commonly used as animal feed, new demand from the biofuels industry might affect the availability and cost of meat. In Southeast Asian countries where China is paying generously for stockpiles of cassava, [farmers may be tempted to grow the crop](#) instead of, for example, other vegetables or rice.

“This is becoming a more valuable cash crop,” Mr. Harris said. “The farmland is limited, so the more that is devoted to fuel, the less is devoted to food.”

Biofuels development in wealthier nations has already proved to have a powerful effect on the prices and the cultivation of crops. Encouraged by national biofuel subsidies, nearly 40 percent of the corn grown in the United States now goes to make fuel, with prices of corn on the [Chicago Mercantile Exchange](#) rising 73 percent from June to December 2010.

Such price rises also have distant ripple effects, food security experts say. “How much does the price of corn in Chicago influence the price of corn in Rwanda? It turns out there is a correlation,” said Marie Brill, senior policy analyst at [ActionAid](#), an international development group. The price of corn in Rwanda rose 19 percent last year.

“For Americans it may mean a few extra cents for a box of cereal,” she said. “But that kind of increase puts corn out of the range of impoverished people.”

Higher prices also mean that groups like the World Food Program can buy less food to feed the world’s hungry.

A version of this article appeared in print on April 7, 2011, on page A1 of the New York edition.

6. Hook: Opening Jack Pine Cones

Course: Grade 11 Academic Biology	Course Code: SBI3U
Unit Title: Plants	Topic: (varies, see teacher note)
Lesson Title: (varies, see teacher note)	
Category: Basic Concepts of Science – plant reproduction and succession	

Curriculum Expectations addressed:

Big Idea: Plants have specialized structures with distinct functions that enable them to respond and adapt to their environment.

F2. investigate the structures and functions of plant tissues, and factors affecting plant growth;

F2.1 use appropriate terminology related to plants, including, but not limited to: *mesophyll*, *palisade*, *aerenchyma*, *epidermal tissue*, *stomata*, *root hair*, *pistil*, *stamen*, *venation*, *auxin*, and *gibberellin* [C]

F3.5 explain the process of ecological succession, including the role of plants in maintaining biodiversity and the survival of organisms after a disturbance to an ecosystem

Assessment Tasks/Activities, Strategies and Recording Devices:

Tasks/Activities	Assessment Strategies	Assessment Types	Recording Devices
Burn jack pine cones	Teacher observations during discussion	For learning	Teacher notes

Instructional Focus:

Teaching/Learning Strategies: <ul style="list-style-type: none"> Hands-on, kinetic activity Mini-consolidation discussion 	Student Groupings: <ul style="list-style-type: none"> Groups of 3-4 Mixed ability
Differentiation Strategies: <ul style="list-style-type: none"> Provides a physical activity for kinetic learners, and a verbal debrief for auditory learners. 	
Adaptations/Accommodations for Exceptional Students: <ul style="list-style-type: none"> The directions for this activity will be provided verbally and in writing. The handout will use an easy-to-read font. 	

Notes and Reminders

- This lesson plan is only for the minds on portion of the lesson. It is designed as a review of some of what is learned in the plants section of the Diversity of Living Things unit.
- This hook allows students to see one of the more interesting properties of plants, serotiny, and to understand the role serotiny plays in succession.
- Activity instructions are found on the teacher copy of the handout.

Sources

- Jack Pine. (n.d.). In *Wikipedia*. Retrieved from: http://en.wikipedia.org/wiki/Jack_Pine.
- Millson forestry Service Inc; 705-264-3426; www.millsonforestry.com; to purchase Jack Pine Cones

Lesson Outline			
Objectives (learning goals): <ul style="list-style-type: none"> By the end of class students will be able describe one adaptation that helps a species repopulate after a forest fire. 			
15	Minds On	<ul style="list-style-type: none"> Supply each group with 1 jack pine cone Initiate brainstorming about what it is, and why it might look like that? Distribute handout and go over instructions verbally. When groups have finished the activity they should discuss among themselves what happened and why they think it happened 	Materials and Resources Required <ul style="list-style-type: none"> Student handouts 1 jack pine cone/group 1 tea light/group 1 naturally open jack pine cone 1 pair of tongs/group 1 lg petri dish/ group Goggles for all students Matches Paper towels to clean up
	Action	Gymnosperms and Angiosperms Review	
	Consolidation and Debrief	TBD	Key Vocabulary <ul style="list-style-type: none"> Serotiny
	Next Steps	TBD	

Safety Note:

This activity involves the students burning materials over open flames. All necessary precautions should be taken. The students should be aware of the location of the fire extinguisher, all students should wear goggles and the activity should be done over a non-flammable surface. Students may have a tendency to underestimate the tea lights as they are not as strong as Bunsen Burners, but there is still fire involved and students should only be allowed to participate if they behave in a responsible manner.

Appendix A: Burning Jack Pine Cones

During this activity you will be using a candle to burn the Jack Pine Cone that your group has been given. You will burn it until you notice a change in the cone. Then you will discuss your observations with your group and be prepared to take them up with the rest of the class. Please follow the instructions carefully to avoid injury.

1. Gather all materials.
 - a. A Jack Pine Cone
 - b. A petri dish
 - c. A tea light and ceramic tile to hold it
 - d. A pair of Tongs
 - e. Goggles for all group members
2. Ensure you are able to hold the cone in the tongs.
3. Set up tea light on the tile with the petri dish nearby, to allow for easy transfer of the hot cone.
4. Put on goggles. All group members must wear goggles to proceed.
5. When all materials are set up light the tea light with a match, or ask the teacher for assistance.
6. Holding the Jack Pine Cone with the tongs, place the cone in the flame.
7. Hold the cone in the flame, and let it remain even when it begins to burn.
8. You may move the flame to touch different parts of the cone aiming to burn much of the cone.
9. When you notice a change with most of the cone you can place the hot cone in the petri dish to cool.
10. Discuss your the change, and why you think this might be important.
11. When the cone is cool you may take a closer look. Note: the burn cone will be coated in soot and so if you touch it you will need to wash your hands.

Discussion Notes:

What happened?

Why might this be helpful to the Jack Pine Tree?

Appendix B: Burning Jack Pine Cones – Teacher Copy

During this activity you will be using a candle to burn the Jack Pine Cone that your group has been given. You will burn it until you notice a change in the cone. Then you will discuss your observations with your group and be prepared to take them up with the rest of the class. Please follow the instructions carefully to avoid injury.

1. Gather all materials.
 - a. A Jack Pine Cone – to distribute at the beginning of class
 - b. A petri dish and a ceramic tile to hold it
 - c. A tea light
 - d. A pair of Tongs
 - e. Matches
 - f. Goggles for all group members -- Another student can get these
2. Ensure you are able to hold the cone in the tongs.
3. Set up tea light on the ceramic tile with the petri dish nearby, to allow for easy transfer of the hot cone.
4. Put on goggles. All group members must wear goggles to proceed.
5. When all materials are set up light the tea light with a match, or ask the teacher for assistance.
6. Holding the Jack Pine Cone with the tongs, place the cone in the flame.
7. Hold the cone in the flame, and let it remain even when it begins to burn.
8. You may move the flame to touch different parts of the cone aiming to burn much of the cone.
9. When you notice a change with most of the cone you can place the hot cone in the petri dish to cool.
10. Discuss your the change, and why you think this might be important.
11. When the cone is cool you may take a closer look. Note: the burn cone will be coated in soot and so if you touch it you will need to wash your hands.

Discussion Notes:

What happened?

To ensure the students notice while observing during the activity:

The pine cone opened. After burning the pine cone opens and looks more like a normal pine cone.

Why might this be helpful to the Jack Pine Tree?

To ensure the students discuss during the mini-consolidation:

- Serotiny – this word should be written on the board so students can copy it. Serotiny refers to an adaptation that allows plants to protect their seed until an environmental stimulus appears in this case fire.
- This will allow Jack Pines to release their seeds during a forest fire so they can quickly repopulate.
- See if students find any problems with this adaptation (seeds are only released in fire how else can they reproduce?)
 - Cones close to the ground will open after several hot days, cones near the top stay closed.

Part Two: The Summative Test



Name: _____

Date: _____

SBI3U Summative Test: Student Copy

Plants – Anatomy, Growth and Function

Marks total:	K/U	APP	Comm	T/I
/71	/17	/15	/15	/24

Communication skills will be marked on the test as a whole using this rubric:

Remedial (0 - 7 marks)	Level 1 (7.5 – 8.5 marks)	Level 2 (9 – 10 marks)	Level 3 (10.5 11. 5 marks)	Level 4 (12 – 15 marks)
No evident organization of thoughts. Vocabulary and terminology usage is inaccurate making it difficult to understand.	Organises thoughts and work with limited effectiveness; rarely chooses an effective organization strategy. Uses the vocabulary and terminology with limited accuracy.	Organises thoughts and work with some effectiveness; sometimes chooses an effective organization strategy. Uses the vocabulary and terminology with some accuracy.	Organises thoughts and work with considerable effectiveness; often chooses an effective organization strategy. Uses the vocabulary and terminology with considerable accuracy.	Organises thoughts and work with thorough effectiveness; always chooses most effective organization strategy. Uses the vocabulary and terminology with thorough accuracy.

***Note:** Spelling and grammar will not affect the communication mark as long as the work is legible and the teacher can determine the meaning of the answers.

A. MULTIPLE CHOICE: Choose the MOST correct response by circling it. (10 K/U, 10 T/I)

1. Which of the following are ways that plants are used in society?

- | | |
|--------------------|---------------------|
| A. Pharmaceuticals | C. Clothing |
| B. Perfumes | D. All of the above |

Why did you choose this answer? _____

2. Which of the following is not an artificial selection strategy used in plants?

- | | |
|------------------------|-------------------|
| A. Mass Selection | C. Cross Breeding |
| B. Pure line Selection | D. Cloning |

Why did you choose this answer? _____

3. Which of the following is not considered a nutrient for plants?

- | | |
|---------------|--------------|
| A. Nitrogen | C. Potassium |
| B. Phosphorus | D. Sodium |

Why did you choose this answer? _____

4. Which of the following processes does not lower plant biodiversity?

- | | |
|-------------------------|--------------------|
| A. Primary Succession | C. Bioaccumulation |
| B. Artificial Selection | D. Monocultures |

Why did you choose this answer? _____

5. What kind of tissue is xylem?

- A. Dead cells for transporting water.
- B. Living cells for transporting sucrose.
- C. Dead cells for transporting sucrose.
- D. Living cells for transporting water.

Why did you choose this answer? _____

6. What do mosses need to live?

- A. A constant supply of sunlight.
- B. A constant supply of moonlight.
- C. A constant supply of fertilizer.
- D. A constant supply of water.

Why did you choose this answer? _____

7. A runner's function is to _____.

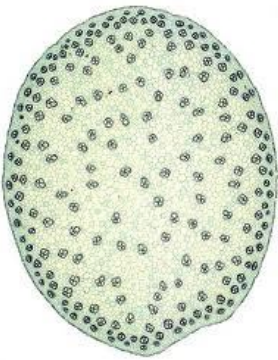

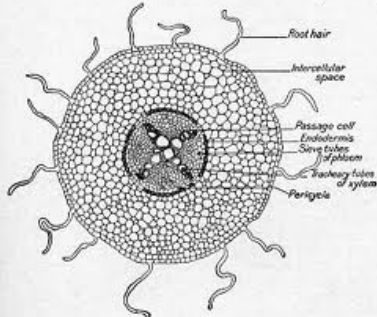
- | | |
|---------------------|--------------|
| A. Store starch | C. Reproduce |
| B. Provide Strength | D. Transport |

Why did you choose this answer? _____

B. TRUE AND FALSE: Choose the most correct response by circling True or False and if it is False, change the sentence to be True. Simply making the sentence negative will not receive full marks. You must demonstrate your understanding by making an appropriate change. (5 K/U; 3 T/I)

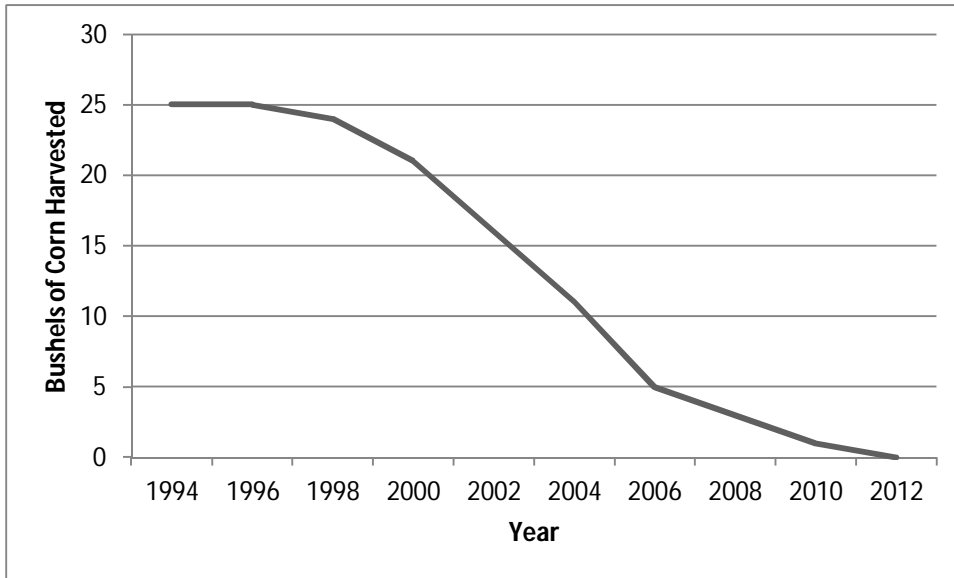
- | | | |
|------------------------------------------------------------|------|-------|
| 1. A sunflower is a non-vascular plant. | True | False |
| 2. A root is covered with a waxy cuticle for protection. | True | False |
| 3. A climax community is characterized by its stability. | True | False |
| 4. Gymnosperm pollination is a form of sexual reproduction | True | False |
| 5. Angiosperms undergo one of either mitosis or meiosis | True | False |

C. STRUCTURES: Fill in the chart below. Be sure to explain your reasons for choosing monocot or dicot clearly and succinctly in the "how do you know?" section. (5 K/U)

			
What is this a picture of?			
What is its purpose in a plant?			
Is it a monocot or dicot?			
How do you know?			

D. SHORT ANSWER: Answer the following questions in the space below.

1. The following graph tracks the amount of corn harvested from Old McDonald's farm.



Over the past 10 years there has been a huge market demand for corn, so this farm has grown corn exclusively.

Part I. Using the above information explain what you see in the graph. (3A)

Part II. Suggest 2 possible strategies that the farmer can use to improve crop production and explain your reasoning. (4A)

2. Read the following excerpt from the “Ethanol Fact Sheet” published by the Canadian Renewable Fuels Association:

ISSUE: Food Prices

Isn't it true that ethanol is raising the price of food?

No. Ethanol is made from a variety of sources including crops that are in large surplus beyond what is required to meet both our food and our fuel needs.

- **A grain surplus.** Canada typically produces just less than 50 million tonnes of grain (wheat, barley, corn, oats, rye) annually, and exports about half of it. Consider: if all Canadian gasoline contained 10% ethanol, about 8 to 9 million tonnes of grain would be required. Even at this level, Canada would remain a major grain exporter.
- **Not all corn is created equal.** Grain ethanol can be produced using any grade of corn meaning that industrial yellow corn is most commonly used. Additionally, ethanol produced from corn only uses the starch from the grain, the remaining protein, fat and minerals is used in animal feed. Renewable fuels production provides a market for damaged or low-grade crops which can be used without affecting quality. In addition, ethanol is made from yellow corn while the most common food corn around the world is white corn.

- a. What is the bias and what did you use to determine that bias? (2 T/I)
- b. Using the above article and your knowledge of biofuels write a short persuasive paragraph from a different perspective or bias. (4 A)

3. Explain the purpose of stomata. What can we infer about a plant with very few stomata? Why? (3 T/I)

4. Compare and Contrast one natural and one artificial method of plant reproduction. Include in your comparison a situation when each one would be more desirable. (6 T/I)

5. Why are grafting and root cutting the two most common methods of plant reproduction used commercially? (3 T/I)

6. A farmer has noticed that her crops are growing at a faster rate this season than the season before. In this growing season, there has been more rainfall than usual and the temperature has been generally warmer.

The farmer wants to know why her crops are growing so quickly. Briefly outline the **key points** that you need to consider when creating an experiment you would perform to explain what is causing this fast growth. (4 A)

Name: _____

Date: _____

SBI3U Summative Test: Teacher Copy

Plants – Anatomy, Growth and Function

Marks total:	K/U	APP	Comm	T/I
/71	/17	/15	/15	/24

Communication skills will be marked on the test as a whole using this rubric:

Remedial (0 - 7 marks)	Level 1 (7.5 – 8.5 marks)	Level 2 (9 – 10 marks)	Level 3 (10.5 11. 5 marks)	Level 4 (12 – 15 marks)
No evident organization of thoughts. Vocabulary and terminology usage is inaccurate making it difficult to understand.	Organises thoughts and work with limited effectiveness; rarely chooses an effective organization strategy. Uses the vocabulary and terminology with limited accuracy.	Organises thoughts and work with some effectiveness; sometimes chooses an effective organization strategy. Uses the vocabulary and terminology with some accuracy.	Organises thoughts and work with considerable effectiveness; often chooses an effective organization strategy. Uses the vocabulary and terminology with considerable accuracy.	Organises thoughts and work with thorough effectiveness; always chooses most effective organization strategy. Uses the vocabulary and terminology with thorough accuracy.

***Note:** Spelling and grammar will not affect the communication mark as long as the work is legible and the teacher can determine the meaning of the answers.

A. MULTIPLE CHOICE: Choose the MOST correct response by circling it. (10 K/U, 10 T/I)

1. Which of the following are ways that plants are used in so

- A. Pharmaceuticals
B. Perfumes
C. Clothing
D. All of the above

Why did you choose this answer? Medicines come from plants, cotton, and perfume often comes from flowers

2. Which of the following is not an artificial selection strategy

- A. Mass Selection
B. Pure line Selection
C. Cross Breeding
D. Cloning

Why did you choose this answer? Cloning is used for animals

Note: The 'why' questions with the multiple choice would be used in all summative tests to ensure that students are not just guessing. The students would be introduced to such questions early in the term and would therefore be ready for them by this test.

The answers that are included are examples; there would be many possible correct answers.

3. Which of the following is not considered a nutrient for plants?

- A. Nitrogen
- B. Phosphorus
- C. Potassium
- D. Sodium

Why did you choose this answer? Sodium is a nutrient for animals.

4. Which of the following processes does not lower plant biodiversity?

- C. Primary Succession
- D. Artificial Selection
- C. Bioaccumulation
- D. Monocultures

Why did you choose this answer? Succession increases biodiversity.

5. What kind of tissue is xylem?

- E. Dead cells for transporting water.
- F. Living cells for transporting sucrose.
- G. Dead cells for transporting sucrose.
- H. Living cells for transporting water.

Why did you choose this answer? Xylem is for transpiration which is a passive process so dead cells work.

6. What do mosses need to live?

- E. A constant supply of sunlight.
- F. A constant supply of moonlight.
- G. A constant supply of fertilizer.
- H. A constant supply of water.

Why did you choose this answer? They are non-vascular

7. A runner's function is to _____.

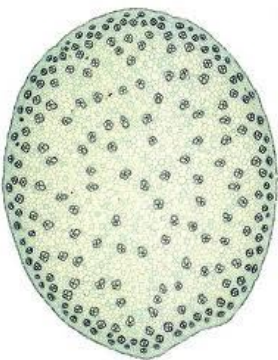

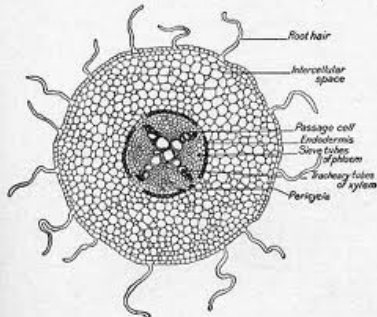
- C. Store starch
- D. Provide Strength
- C. Reproduce
- D. Transport

Why did you choose this answer? It plants in the ground away from the original plant and produces a new plant.

B. TRUE AND FALSE: Choose the most correct response by circling True or False and if it is False, change the sentence to be True. Simple making the sentence negative will not receive full marks. You must demonstrate your understanding by making an appropriate change. (5 K/U; 3 T/I) (Note: some students may figure out from the marks that there are 3 false statements. This is considered to be an excellent use of reasoning skills and therefore not seen as a concern.)

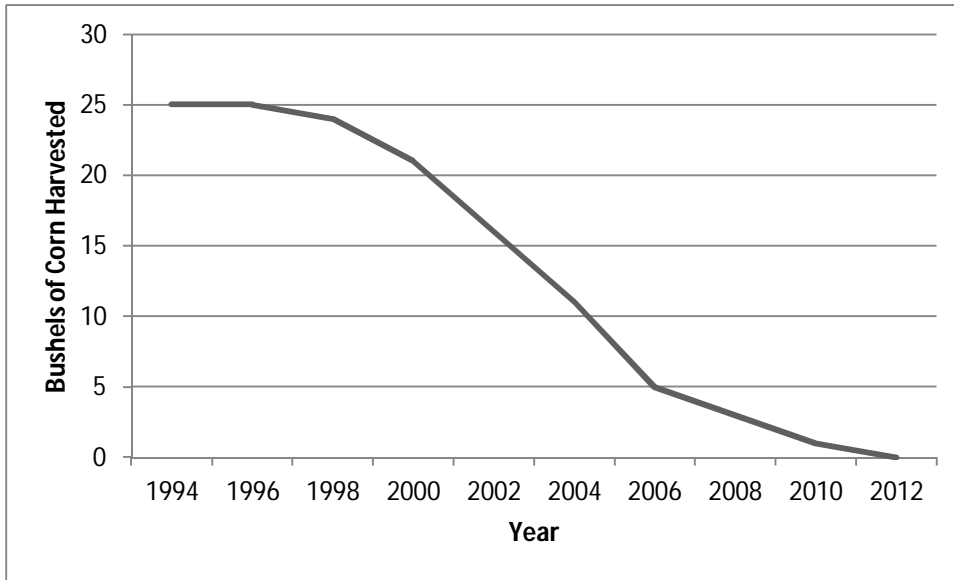
1. A sunflower is a ~~non~~-vascular plant. True **False**
2. A ~~root~~ stem is covered with a waxy cuticle for protection. True **False**
3. A climax community is characterized by its stability. **True** False
4. Gymnosperm pollination is a form of sexual reproduction **True** False
5. Angiosperms undergo ~~one~~ both of either mitosis ~~or~~ and meiosis True **False**

C. STRUCTURES: Fill in the chart below. Be sure to explain your reasons for choosing monocot or dicot clearly and succinctly in the "how do you know?" section. (5 K/U)
(Note: ½ a mark for each answer; if answers to 1 or 3 are incorrect and the answers to 2 or 4 correspond to the answers given in 1 or 3 then marks will be given for 2 and 4.)

			
1. What is this a picture of?	Stem	Leaf	Root
2. What is its purpose in a plant?	Stability/Transport/Storage	Photosynthesis	Retrieving water/nutrients Storage
3. Is it a monocot or dicot?	Monocot	Dicot	
4. How do you know?	Scattered vascular bundles	Net like veins	

D. SHORT ANSWER: Answer the following questions in the space below.

1. The following graph tracks the amount of corn harvested from Old McDonald's farm.



Over the past 10 years there has been a huge market demand for corn, so this farm has grown corn exclusively.

Part I. Using the above information explain what you see in the graph. (3A)

Answer: The farm is employing monocultures as its agricultural practice. Since this farm is only growing corn, the drop in crop production over the years is due to decreasing soil fertility.

Part II. Suggest 2 possible strategies that the farmer can use to improve crop production and explain your reasoning. (4A)

Answer: The corn crop has been exhausting the same type of nutrients from the soil, without giving the soil an opportunity to replenish the assimilated nutrients. Two possible strategies that can help improve this farm's corn production would be to try crop rotation and use fertilizer to replenish the soil's nutrients that has used up by the corn.

2. Read the following excerpt from the “Ethanol Fact Sheet” published by the Canadian Renewable Fuels Association:

ISSUE: Food Prices

Isn't it true that ethanol is raising the price of food?

No. Ethanol is made from a variety of sources including crops that are in large surplus beyond what is required to meet both our food and our fuel needs.

- **A grain surplus.** Canada typically produces just less than 50 million tonnes of grain (wheat, barley, corn, oats, rye) annually, and exports about half of it. Consider: if all Canadian gasoline contained 10% ethanol, about 8 to 9 million tonnes of grain would be required. Even at this level, Canada would remain a major grain exporter.
- **Not all corn is created equal.** Grain ethanol can be produced using any grade of corn meaning that industrial yellow corn is most commonly used. Additionally, ethanol produced from corn only uses the starch from the grain, the remaining protein, fat and minerals is used in animal feed. Renewable fuels production provides a market for damaged or low-grade crops which can be used without affecting quality. In addition, ethanol is made from yellow corn while the most common food corn around the world is white corn.

- a. What is the bias and what did you use to determine that bias? (2 T/I)

The bias is pro-ethanol. Several excerpts can be used to explain the reasoning.

- b. Using the above article and your knowledge of biofuels write a short persuasive paragraph from a different perspective or bias. (4 A)

Varied answers evaluated for the presence of a different view point and having that viewpoint relevant and backed up with accurate information.

3. Explain the purpose of stomata. What can we infer about a plant with very few stomata? Why? (3 T/I)

Answer: control the movement of gasses in/out and water out. That it is in a very dry climate as the smaller number of stomata will allow for less water loss.

4. Compare and Contrast one natural and one artificial method of plant reproduction. Include in your comparison a situation when each one would be more desirable. (6 T/I)

Answers will vary in organization (can use a graphic organizer here).

Answers will also vary depending on choice:

Natural: angiosperm and gymnosperm pollination

Artificial: grafting, root cutting, and leaf cutting

5. Why are grafting and root cutting the two most common methods of plant reproduction used commercially? (3 T/I)

Root cutting and grafting are most common methods of plant reproduction used for commercial purposes because they require a lot less time, and allow one to produce plants with an increased level of resistance to soil-borne problems caused by insect, nematode and disease attack. Grafting also provides a means to repair damaged plants, to change the form or variety of plants, optimize pollination and cross pollination, and to create plants that are better able to thrive in a wider range of environmental conditions.

6. A farmer has noticed that her crops are growing at a faster rate this season than the season before. In this growing season, there has been more rainfall than usual and the temperature has been generally warmer.

The farmer wants to know why her crops are growing so quickly. Briefly outline the **key points** that you need to consider when creating an experiment you would perform to explain what is causing this fast growth. (4 A)

Answer:

- 1 control – average water and temp
- 1 plant this year's temp
- 1 plant this year's water
- Keep all other conditions the same as average years